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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

FEBRUARY

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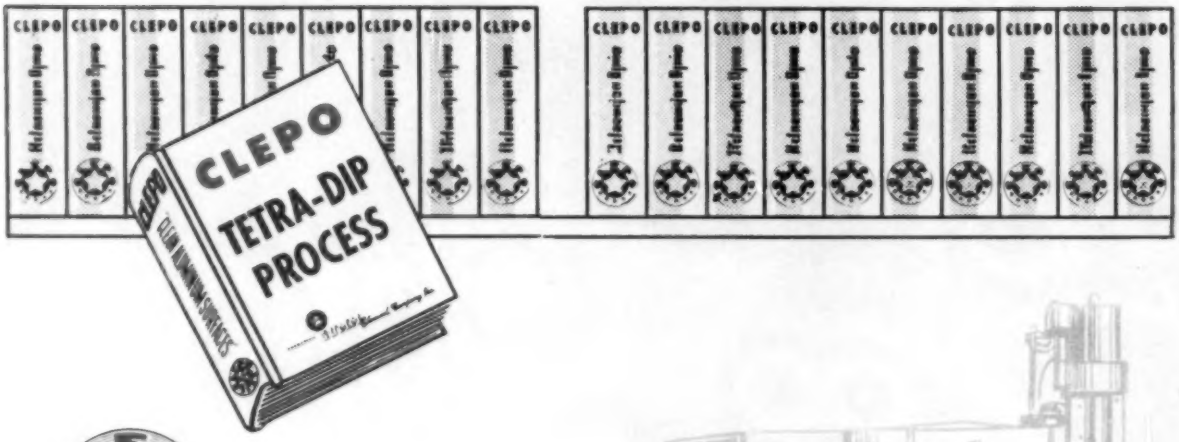

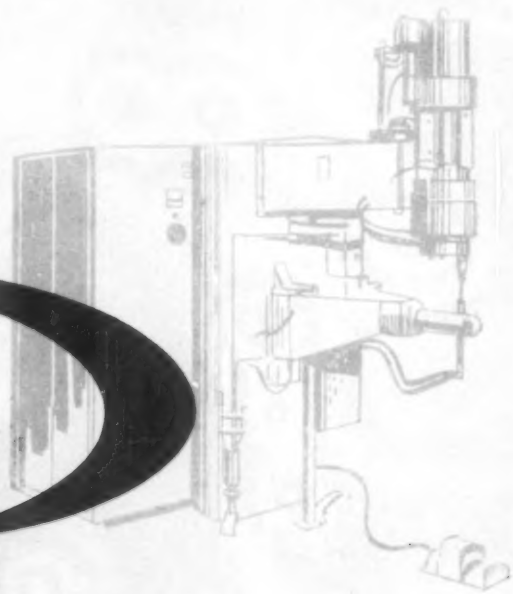

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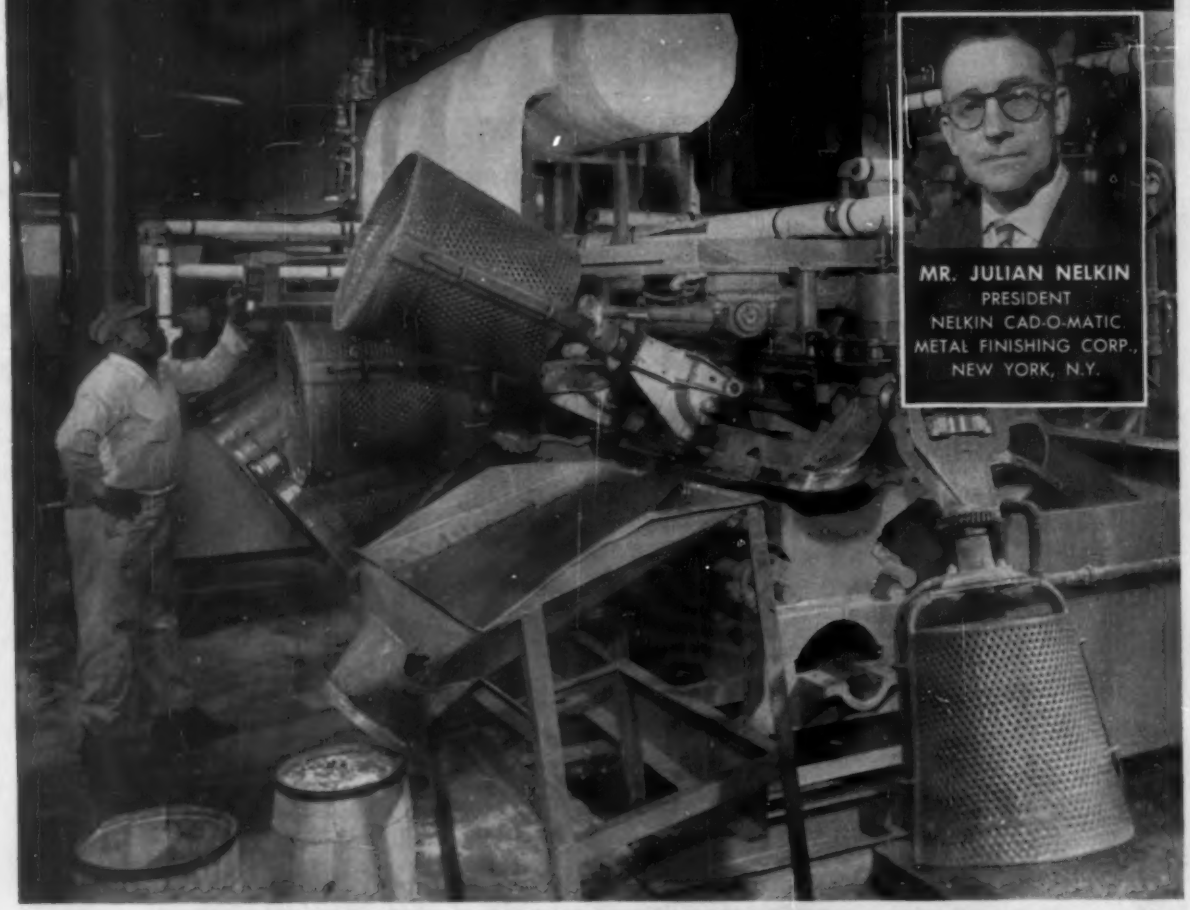

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Journal of the American Electroplaters' Society

February 1958 — **Vol. 45, No. 2**

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Published by the American Electroplaters' Society, Incorporated, 445 Broad Street, Newark 2, N. J. Phone: HUmboldt 2-3400. Yearly subscription for Members $2.00. Nonmembers U. S. and Canada $5.00, 65c a copy. Foreign, $8.00 a year, $1.00 a copy.

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PLATING is abstracted regularly in Chemical Abstracts, Metals Review, Metallurgical Abstracts, Engineering Index, Technical Data Digest, and Bulletin Analytique.

Statements of fact and of opinion given in articles and papers in PLATING are those of the contributors. The American Electroplaters' Society assumes no responsibility for them.

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Published monthly at 5800 N. Mervine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1912.

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EDITORIAL

STRIKING THAT $9,990 BLOW

YEARS AGO when many of America's machines of mass production were still substantially in their experimental stage, a prominent industrialist brought an eminent engineer into his plant to diagnose the ills of a promising machine that, for days, just couldn't be started.

The engineer studied the machine, made his calculations, then tapped it skillfully with an instrument. The machine not only started but also continued thereafter to produce uninterruptedly. The engineer departed and, in due course, the industrialist received from him a bill for $10,000.

After recovering from the initial shock of that charge for striking a single blow, the irate tycoon promptly dispatched a bristling letter of protest to the engineer adding, ". . . and be very sure to itemize your bill."

Back, swiftly, came the bill—in the same amount but itemized. "For striking the blow," it said, "$10." Then it added, "For knowing where, when and how to strike, $9,990."

In our highly competitive business world today, survival of the fittest was never more demanding. As with that engineer, the rewards of vocational competency, generally, go to him that hath, namely to him who has labored to learn, and who has learned to apply effectively, the fruits of his cumulative education and his cumulating experience.

The thirst for professional self-improvement, in all job categories from corporate officer down the ladder, is a main cause for the vast expansion of our educational agencies, including professional societies. It is a prime reason, for instance, for the steady growth of the American Electroplaters' Society (AES) dedicated as this body, and its Branches, its Research Program, its PLATING magazine, its Annual Convention, are to the advancement of electroplating, metal finishing and allied arts.

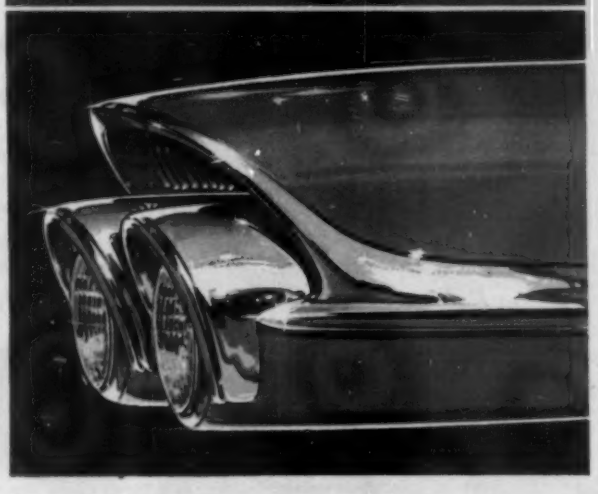
A strength of the AES and other professional societies today is that they not only afford ways for learning and self-improvement but also means whereby experienced men can share the fruits of knowledge with others to common advantage. Hence the mutual importance in this particular field of documenting the products of research and experience, and contributing them in technical paper form either for publication in PLATING or for delivery before the Society's Annual Convention. Hence, moreover, the importance that every AES Branch stimulate and sponsor the preparation and submission of at least one original technical, scientific or practical plating paper per fiscal year for publishing consideration by PLATING or for possible Annual Convention use.

In the end, attainment of this goal will help to fashion more and more of the needed men in this field who, as with that engineer, will know when, where and how to strike that $9,990 blow.

John P. Nichols

Chairman, Editorial Board
and Managing Editor

Since the days of the oil and acetylene headlamp



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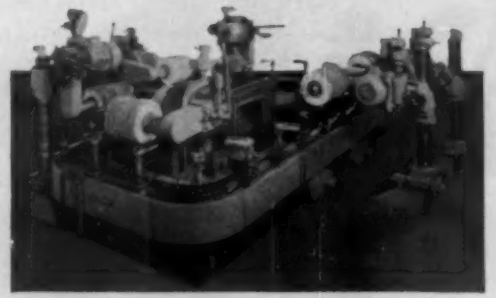

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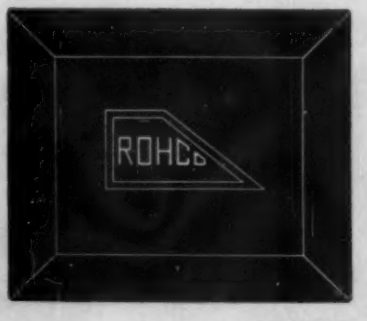

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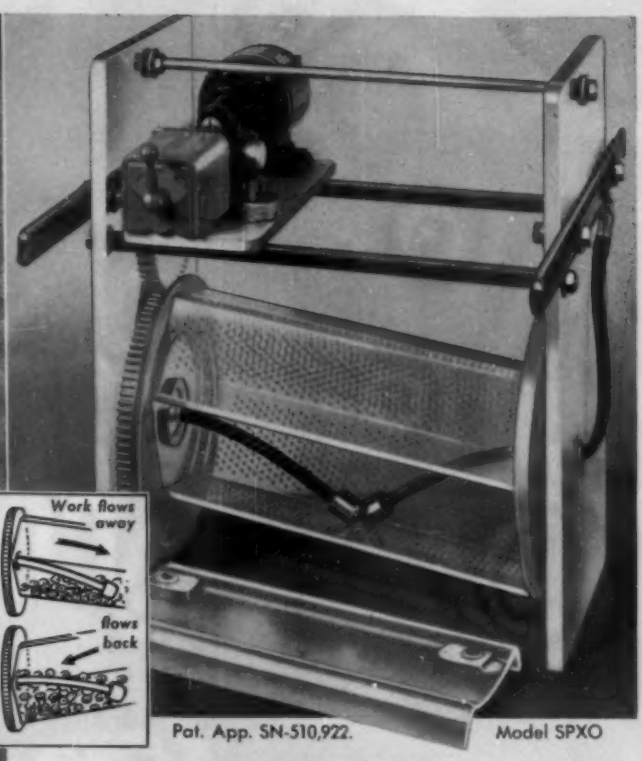

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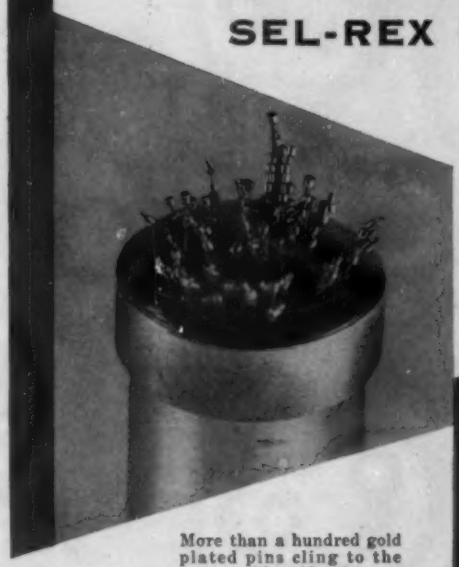

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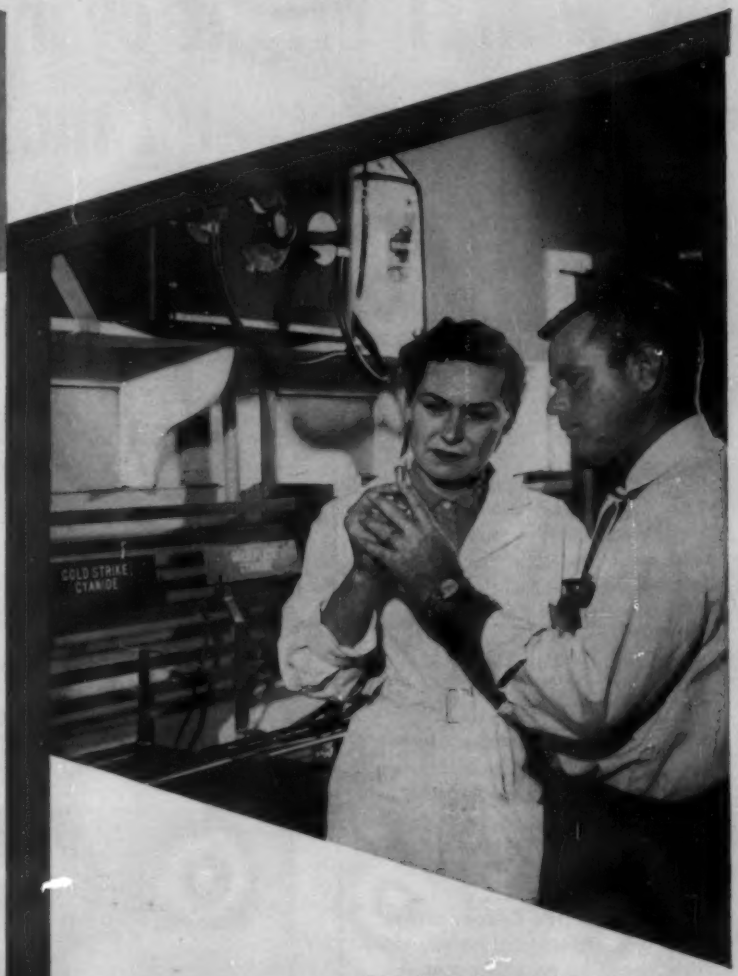

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Metal & Thermit bath uses entirely new addition agents for stability, more dependable operation

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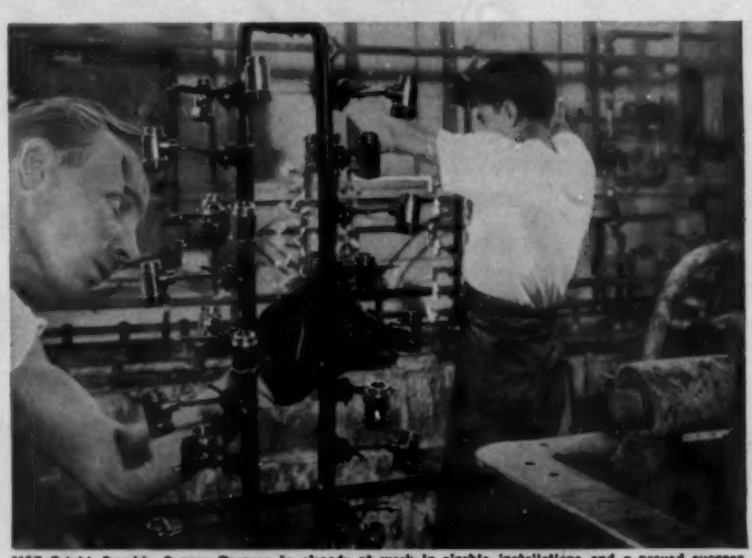
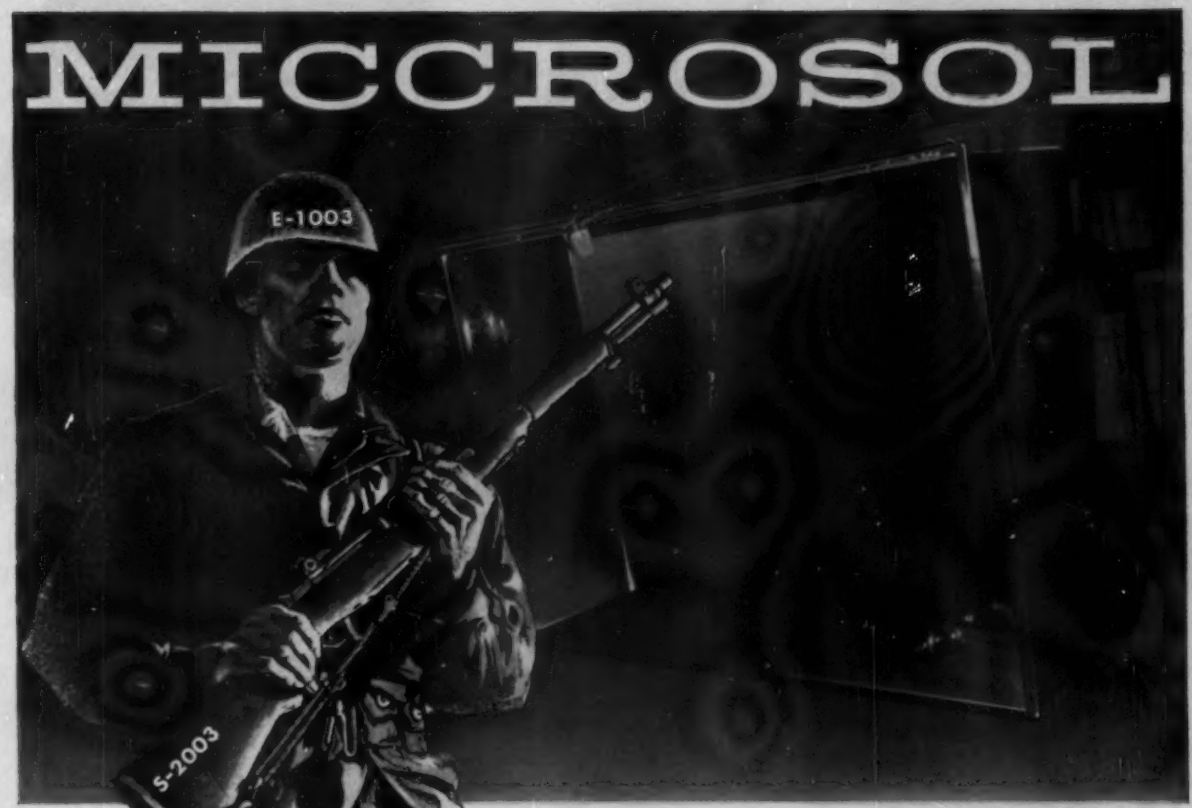


M&T Bright Cyanide Copper Process is already at work in sizable installations and a proved success.
Photo courtesy Pottstown Plating Works, Inc.

MICCROSOL



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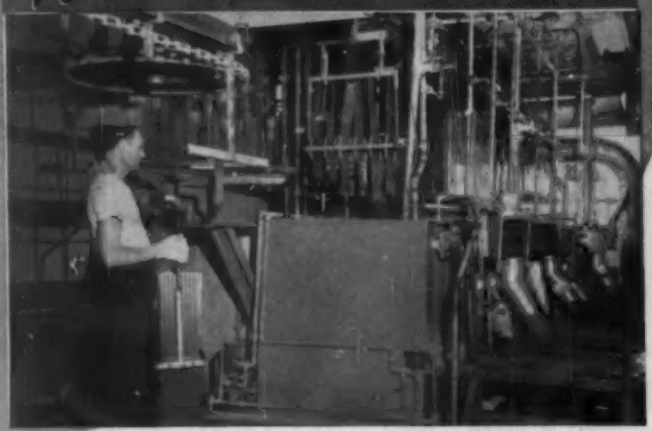
with

Nalcite® ION EXCHANGERS



- REDUCE WASTE DISPOSAL
- RECOVER RINSE WATER
- INCREASE PRODUCTION
- IMPROVE QUALITY
- RECOVER VALUABLE METALS
- LOWER CURRENT DEMAND
- REDUCE REJECTS

You can solve major waste disposal or water conservation problems ... and get *five extra advantages* ...with the Nalcite Ion Exchange process in your plating or anodizing plant.

Check these plus benefits in the list at left. They are important contributions to efficiency and economy in plating processes. We invite you to write, today, for full information on Nalcite Ion Exchangers.

NATIONAL ALUMINATE CORPORATION

6301 West 66th Place • Chicago 38, Illinois

In Canada: Alchem Limited, Burlington, Ontario

Nalco®

PRODUCTS . . . Serving Industry through Practical Applied Science

Save More

IMMEDIATE SHIPMENT!

Select from one of the nation's largest stocks of guaranteed rebuilt electroplating motor generator sets and rectifiers with full control equipment.

PLATERS

1—10,000/5000 AMPERE, 6/12 VOLT **H-VW-M**, Synchronous. Exciter-in-head.
1—8000/4000 AMPERE, 6/12 VOLT, **CHANDEYSSON**, Synch.
1—7500/3750 AMPERE, 9/18 VOLT, **HANSON-VAN WINKLE-MUNNING**, Synchronous.
1—6000/3000 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS**, Synch.
1—5000/2500 AMPERE, 9/18 VOLT, **CHANDEYSSON**, Synchronous. Exciter-in-head.
1—4000/2000 AMPERE, 6/12 VOLT, **H-VW-M**, Synch., Exc.-in-head.
3—3000/1500 AMPERE, 12/24 VOLT, **CHANDEYSSON**, Exciter-in-head.
1—2000/1000 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING.**
1—1500/750 AMPERE, 12/24 VOLT, **CHANDEYSSON**, Synchronous.

ANODIZERS

1—1000 AMPERE, 40 VOLT, **CHANDEYSSON**, 25/C.
1—1000 AMPERE, 30 VOLT, **IDEAL**, Exciter-in-head.
1—750 AMPERE, 60 VOLT, **HANSON-VAN WINKLE-MUNNING**, Synchronous. Exciter-in-head.
1—500 AMPERE, 25 VOLT, **CHANDEYSSON**, Synchronous. Exciter-in-head.
4—400 AMPERE, 40 VOLT, **M. G. C.**, Separately Excited.

RECTIFIERS

1—**G. E.** 2000/1000 AMPERE, 6/12 VOLT.
1—**SEL-REX** SELENIUM, 1200 AMPS., 9V, for 440/3/60.
1—**UDYLITE-MALLORY**, 1500/750 AMPERE, 6/12 VOLT.
4—**UDYLITE-MALLORY**, 1440/720 AMPERE, 6/12 VOLT.
1—**RAPID** 1000 AMPERE, 12 VOLT, Germanium, 440/3/60.
1—**RAPID** 750 Amp., 6 V Selenium, Remote Control, 440/3/60 AC.

SPECIAL

2—**CROWN & H-VW-M** Centrifugal Driers No. 1 and No. 2 with Heat.
1—**H-VW-M** Semi Automatic for Cyanide. 15 ft. x 60 in. x 42 in. Can be lined for nickel.
2—**RONCI** Enamelers, No. R-100 & R-200.
2—**ALMCO** DB2 and DB8 Deburring Barrel. 2 Comp. Vari Drive.
1—**HAMMOND** VRO, 7 Variable Speed Buffing Lathe, 7— HP.
2—No. 101 Production Pipe Polishing Machines.
1—No. A-2 **ACME** semi-automatic 2 spindle buffing head.
4—**L'HONKEDIEU** 5 HP variable speed buffing lathes.

Other outstanding values in stock. You'll save more if you check M. E. Baker first for all your Plating, anodizing and metal finishing needs.

M. E. BAKER CO.

Kirkland 7-5460

25 Wheeler St., Cambridge 38, Mass.

NI-PLEX®

New

ONE Nickel Stripping Bath For All Basis Metals.

PATENTS PENDING

NI-PLEX strips nickel from steel, copper, brass, lead, tin, silver, aluminum and zinc die casting metal by simple immersion without injury to the base metal. It also strips cadmium.

NI-PLEX is the only effective and safe nickel stripper for parts containing two or more base metals.

NI-PLEX contains no cyanides, caustic or acids: does not fume.

NI-PLEX does not pit or corrode.

NI-PLEX bath is operated from room temperature to 80°C.

NI-PLEX bath is stable for long periods of time — in use or standing — at low or high temperatures.

NI-PLEX is economical. Nothing is wasted. 100% efficiency. Nickel can be reclaimed.

CORROSION RATES OF VARIOUS BASIS METALS WHEN IMMERSED IN NI-PLEX AT 175°F. FOR 1 HOUR . . .

STEEL	No Measurable Corrosion
COPPER	No Measurable Corrosion
BRASS	No Measurable Corrosion
ZINC	Less than 0.0002 inches
LEAD	Less than 0.00008 inches*
ALUMINUM	Less than 0.00004 inches

*½lb. Sodium Carbonate per gallon added to bath

United Chemical Corporation of New England
45 Seekonk Street
Providence 6, R. I.

☐ Please send us parcel post prepaid enough NI-PLEX for 1 gallon bath with instructions.
☐ Check enclosed. ☐ Purchase order enclosed.
☐ Please send us NI-PLEX literature.

Company .....

Address .....

Attn. of .....

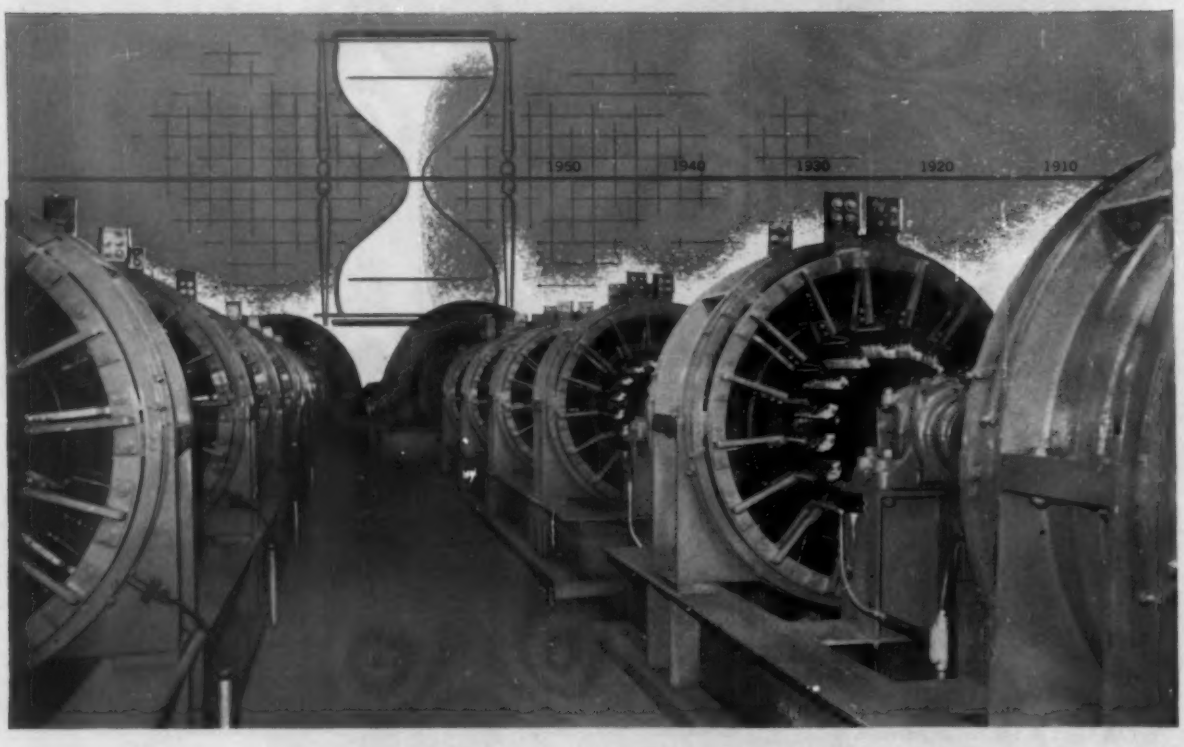
SEND $4.00 or PURCHASE ORDER FOR ENOUGH NI-PLEX TO MAKE UP 1-GALLON BATH

UNITED CHEMICAL CORPORATION

OF NEW ENGLAND

45 SEEKONK STREET,
PROVIDENCE 6, R. I.
PLANTATIONS 1-2800

LONGEST **life**... AT HIGHEST CONTINUOUS PERFORMANCE



...PROOF THAT MOTOR GENERATORS ARE YOUR BEST INVESTMENT IN POWER CONVERSION EQUIPMENT

Chandeysson **generators live 4 times longer—no efficiency drop due to age or overload**

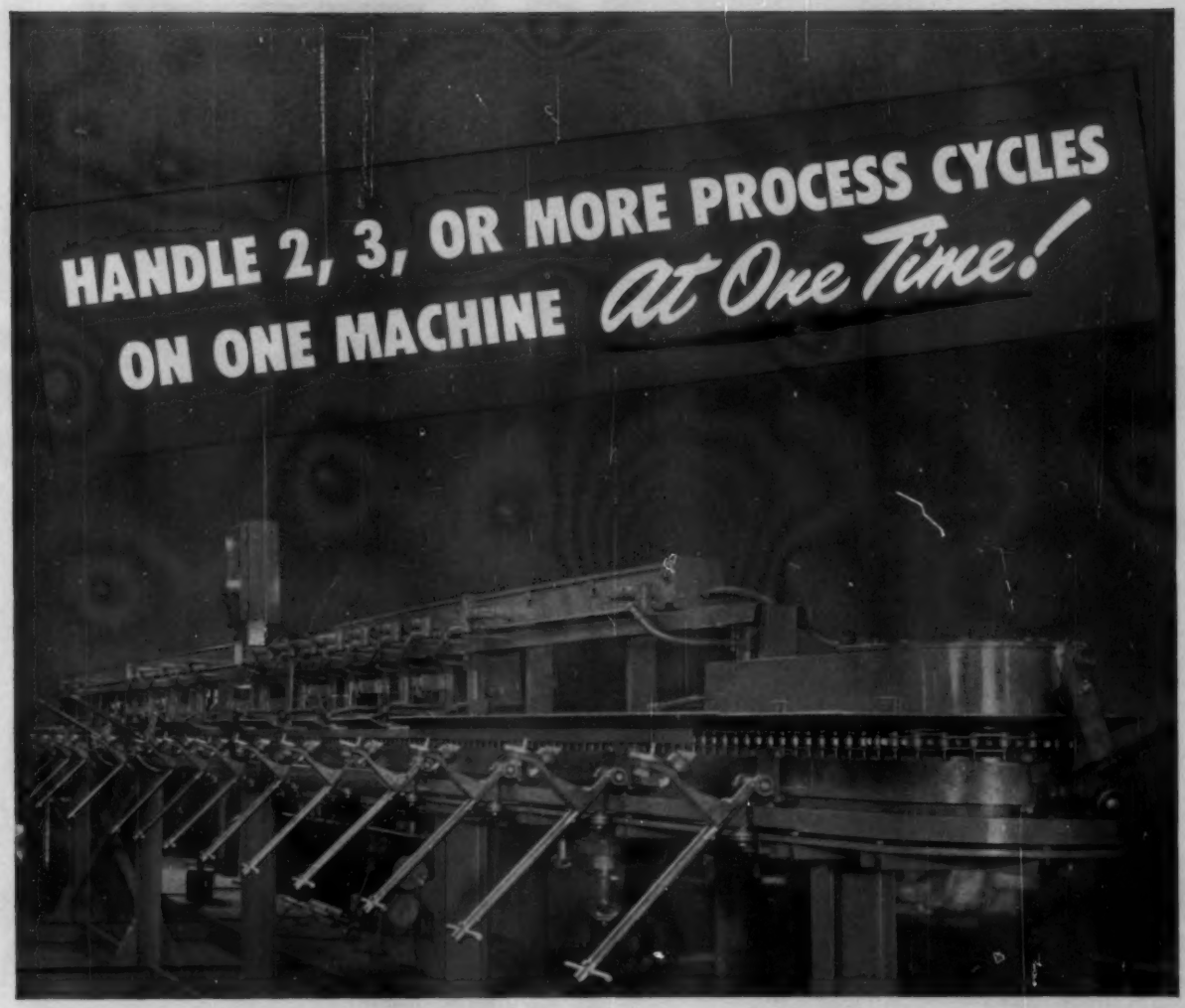
When you buy a Chandeysson Motor Generator, you're investing in lifetime power conversion of highest quality performance, exceptionally low maintenance cost. Year in and year out, Chandeysson M. G. sets keep running steadily, *dependably*. Life expectancy is well over 40 years . . . compared to possibly 10 years for other forms of power conversion equipment. Also, Chandeysson sets give you sustained, lifetime overall efficiency . . . as high as 85% . . . that doesn't decrease with age or overload.

Long life is just one of many reasons why the plating industry *insists* on Chandeysson low-voltage generators for direct current power needs . . . for extra capacity to meet emergencies at the lowest possible cost.

For full information, write now for new booklet D-103.

CHANDEYSSON ELECTRIC COMPANY

4078 Bingham Avenue • St. Louis 16, Missouri



LASALCO'S *Select-O-Matic*

MULTIPLE PROCESS PLATER

Another Lasalco development that offers the industry the last word in *fully automatic* plating!

With the new Select-O-Matic, the operator simply selects the desired process cycle for individual racks, when loading the machine, merely by turning a dial on the carrier. From that point, the rack *automatically* travels through the entire selected cycle without further attention.

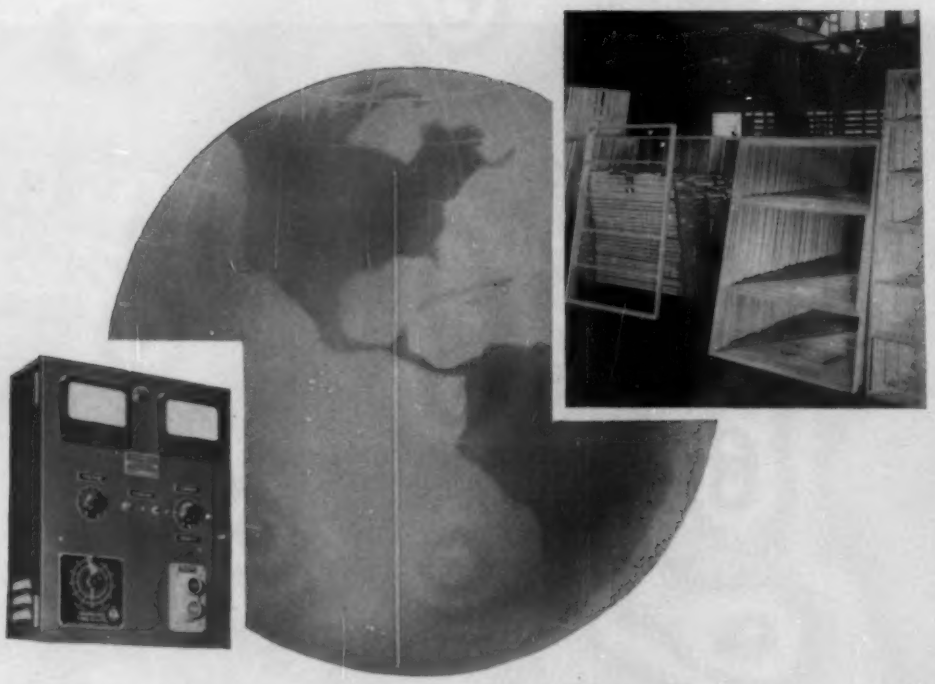
A single Select-O-Matic plater, manned by one operator, will handle several various processes simultaneously. Different machines for each process are eliminated—original investment in equipment is greatly reduced—much less floor space is needed—maintenance is cut to an absolute minimum.

The Select-O-Matic is easily adaptable to any operation. Tell Lasalco about *your* operation and requirements to learn what this new machine can do for *your* production and profits.

Write Today!

LASALCO, INC.

HOME OFFICE: 2820 LaSalle St. • St. Louis 4, Mo. • PRospect 1-2990
IN TEXAS: 2805 Allen Street • Dallas, Texas • Riverside 7-5814



"There's a world of difference in Anodizing when you have Automatic Current Density Control" . . .

. . . says John Gurniak of

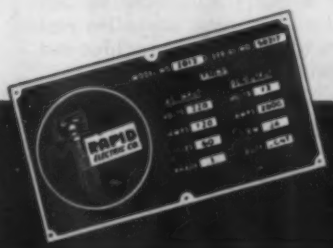
MICHAEL FLYNN MFG. CO., PA.

"and that big difference is the accuracy and simplicity in which a pre-determined film thickness can be controlled."

"We chose RAPID ELECTRIC'S Automatic Current Density Control rectifiers to eliminate the problem of estimating current densities with each load change. One setting, and the rectifier automatically maintains a constant current density per square foot of work."

"It's that easy".

"Once more, with the possibility of over-current virtually eliminated, MICHAEL FLYNN'S high standard of quality is assured."



THE NAMEPLATE THAT MEANS *"More Power to You!"*

RAPID ELECTRIC COMPANY

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 216.

FOR BRIGHT ZINC LIKE THIS . . .

Only *Dual Action* ISO-BRITE® ZB567

Rustproofing, Inc., President, Angelo Melone says: "Our automotive customers demand top quality brightness. ZB567 gives us an outstanding finish and enables us to meet competition and make a fair profit, too."

- PRODUCES FULL BRIGHTNESS
- COST LESS PER POUND
- STANDS UP LONGER

and

PERFORMS EQUALLY WELL IN BOTH BARREL AND RACK PLATING

Substantial benefits for the plating plant and its customers! That's just what the record shows for Wagner's new Iso-Brite ZB567® and until you get an opportunity to prove our claims in your own tanks, be guided by the experience of a progressive plating plant which has used Iso-Brite ZB567 for many months:

Rustproofing, Inc., Detroit, now uses Iso-Brite ZB567 exclusively for both its lines—barrel and rack—thus reducing inventory greatly. The cost is appreciably less than their former additive which, however, could not be used successfully in both lines. Also according to Angelo Melone, Rustproofing president, less additive is required to achieve high quality brightness and only small daily additions are needed to maintain full efficiency. In addition, Rustproofing's freight charges are nil since the Wagner warehouses are located close to the centers of mass production. And perhaps above all, Rustproofing keeps its many customers completely satisfied with the fully bright finish they specify; day to day reliability of ZB567 has reduced rejects to an insignificant minimum.

If your production requires the protection of zinc plating, plus the appeal of an attractive, bright finish, you're money and customer satisfaction ahead when there's Iso-Brite ZB567 in the tanks. If you're handling small "bulk" parts which must be barrel plated, you're doubly rewarded by the simplified inventory and low costs of this two-fisted new additive. Now—when increased operating efficiencies offer the only remaining opportunity for meeting and beating competition—investigate this vital Wagner Brothers development. For full information on Iso-Brite ZB567 and the entire Wagner electroplating line of equipment, anodes, chemicals and other supplies, call our representative in your area. He'll be glad to assist you with all plating department problems.

MANUFACTURERS AND PROCESSORS OF ALL METAL-FINISHING CHEMICALS, ANODES, AND EQUIPMENT

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Wagner BROTHERS INC.

DU PONT PRODUCT NEWS

A new high-speed cyanide copper plating process

DU PONT is now offering a new copper process for plating steel parts and zinc die castings. This new bath has been thoroughly field-tested, and is producing high-quality results on automobile bumpers and grilles, hardware products and wire.

In addition to high-quality results, you get these other advantages with Du Pont's new high-speed copper-plating process:

Low maintenance cost—An inexpensive cyanide electrolyte is used that is easily maintained with Cyanobrik® sodium cyanide or Du Pont high-purity potassium cyanide.

Simplicity—Only two new addition agents are needed. The first is Elchem 1396 which sequesters organic contamination and, by promoting smooth anode corrosion, assists in the production of smooth deposits. The other new addition agent—Elchem 1393—greatly increases the bright plating range of the bath and serves as a brightener.

Low use-cost of addition agents—means Du Pont's new Copper Plating Process is *economical* as well as effective.

Consistent, easily-controlled performance—Day-to-day performance is highly uniform—even after shutdowns. Use of the two addition agents—which are stable in the bath—contributes to this trouble-free operation.

Your existing high-efficiency copper bath can probably be converted to the new Du Pont plating process with minimum disturbance of production. For the complete story on this new high-quality copper-plating process, write or use the coupon on the next page.

Test bumper guards are removed from laboratory experimental copper plating bath. New Du Pont Process gives bright, smooth coatings at higher current densities.

A new plating chemical . . . • sodium copper cyanide double salt . . . is manufactured by Du Pont specifically for make-up and maintenance of copper-plating solutions formulated with sodium cyanide. Advantages: facilitates make-up and replenishment of plating solution, cuts handling of chemicals, eliminates error in bath make-up and replenishment. Check and return coupon for more information.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

FOR MODERN METAL PLATING

Cyanobrik® sodium cyanide gives you extra-high purity, safety and convenience

You can count on outstanding results when electroplating with "Cyanobrik" sodium cyanide. It's a high-purity product whose uniform quality is assured by the production techniques used at Du Pont's modern new plant in Memphis, Tenn.

Just a twist of a wrench is all it takes to unlock the full-open-head drums used to ship "Cyanobrik." Note the absence of sharp or ragged edges. And "Cyanobrik" drums are reclosable—an important feature from Du Pont that can save you money when storing unused contents.

Just look at these specifications for "Cyanobrik":

Sodium cyanide	**96% minimum**
Sodium chloride	**0.2% maximum**
Sulfides (as sulfur)	**0.0005% maximum**

Yet, as this typical analysis shows, Du Pont delivers an even higher-quality product:

Sod. cyanide 97.5%	**Sod. formate . . . 0.35%**
Sod. hydroxide . . . 0.4%	**Sod. chloride. . . 0.1%**
Sod. carbonate . . . 1.5%	**Water 0.15%**

Sulfides (as sulfur) . . . 0.0004% (4 ppm)

This extra-high purity means you can always depend on Du Pont "Cyanobrik" sodium cyanide for your plating jobs—including the most critical.

For your *extra safety and convenience*—Du Pont "Cyanobrik" is shipped in full-open-head drums. There are no exposed or ragged edges when opening or closing drums. The reclosable-drum feature is a Du Pont specialty and provides full protection for the unused contents.

"Cyanobrik" itself is made in the form of 1-ounce, pillow-shaped briquettes. These uniformly sized briquettes are convenient for measuring small quantities. Dusting is minimized, and accidental spillage can be cleaned up quickly and safely.

Another extra—Du Pont service

Du Pont's plating experts—backed up by a fully equipped Sales Technical Laboratory—are always ready to provide on-the-spot service. It's a money-saving advantage you get when ordering sodium cyanide from Du Pont—a reliable domestic supplier—always close at hand.

Call your nearest Du Pont sales office or check and return the coupon.

ELECTROCHEMICALS DEPARTMENT
Sodium Products Division

E. I. DU PONT DE NEMOURS & CO. (INC.)
Wilmington 98, Delaware

P-2

Please send me information and literature on: ☐ New Copper Plating Process ☐ Cyanobrik® sodium cyanide ☐ Sodium copper cyanide double salt

*Name*_____ *Position*_____

*Firm*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

(Advertisement)

Facts to consider when you're buying

Chromate Conversion Coatings

for Corrosion Protection, Paint Base, Decorative Finishing

WHAT IS IRIDITE®?

Briefly, Iridite is the tradename for a specialized line of chromate conversion finishes. They are generally applied by dip, some by brush or spray, at or near room temperature, with automatic equipment or manual finishing facilities. During application, a chemical reaction occurs that produces a thin (.00002" max.) gel-like, complex chromate film of a nonporous nature on the surface of the metal. This film is an integral part of the metal itself, thus cannot flake, chip or peel. No special equipment, exhaust systems or specially trained personnel are required.

If your company is manufacturing or buying parts or complete assemblies made from or plated with any of the more common non-ferrous metals—zinc, cadmium, aluminum, magnesium, silver, copper, brass or bronze—you've probably already run up against the question of finishing these surfaces with a chromate conversion coating. These coatings are used to protect against corrosion, or to provide a base for paint or to provide a decorative finish for sales appeal or shelf life. Since chromate conversion coatings represent a relatively new means of obtaining these finishes, this digest of facts to consider may be of value to you.

1. THE COATINGS THEMSELVES. There are many brands on the market. All are similar in many ways. Each, of course, offers its own specific advantages and these may relate to operating techniques, performance under actual use conditions, cost, availability, etc. Naturally, you'll want to choose a coating that is widely known and accepted under both military and civilian specifications.

2. THE COMPANY BEHIND THE PRODUCT. Is it a reliable, established organization? Does it offer experienced technical service, both from the field-engineering organization as well as the home office and laboratories? The man who sells and services your installation should be thoroughly familiar with not only chromate conversion coatings and their applications, but also with the characteristics and performance of related finishing operations such as precleaning, electroplating, painting, etc. This is most important since all steps of the finishing cycle must be functioning properly for the satisfactory performance of the ultimate finish produced.

3. AVAILABILITY OF THE PRODUCT. Ideally, of course, the material should be readily available to you from nearby warehouses to avoid time loss in long distance shipping and to provide emergency service, should the need arise.

4. COST. Naturally, the initial price of the material is important to you. However, just as you consider ultimate cost when you are buying mechanical equipment, ultimate cost must be considered for these finishing chemicals. So, it will pay you to investigate consumption costs, labor costs and the other factors which go into the determination of ultimate cost. Further, cost alone gives no indication of product performance, so careful attention must be given to the purpose the finish must serve and the value that finish will add to your product.

5. FACILITIES FOR RESEARCH AND DEVELOPMENT. Perhaps the existing types of chromate conversion coatings do not include a compound that will accomplish exactly what you wish. Then, it is important to deal with a supplier who has adequate research and development facilities available to work with you to produce a material to meet your needs. Naturally, such a project is seldom completed overnight. But, with complete cooperation and confidence from both you and your supplier, chances are a satisfactory program can be completed.

These are the concepts of sales and service on which we, Allied Research Products, Incorporated, have developed and marketed the line of Iridite chromate conversion coatings . . . superior product performance, complete sales and technical service, easy product availability, economical cost, extensive research and development facilities. No doubt you are familiar with our line and have seen this trademark—

IRIDITE®

—in our advertising, technical literature or on shipping containers in your plant. Remember this trademark when you're buying or investigating chromate conversion coatings for your company. It's your assurance of quality, economical products from a reliable and established company, skilled sales and technical service from both our home office and a national network of representatives, immediate availability from warehouses in strategic industrial areas and our willingness to work with you to develop new finishes to meet your needs, should the present line fall short.

For complete information on Iridite chromate conversion coatings, write today for your free copy of our technical data file. Or, for immediate advice, call in your Allied Field Engineer. He's listed under "Plating Supplies" in your classified telephone book.

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD.

Manufacturers of Iridite chromate conversion coatings for corrosion resistance, paint systems, final finishing of non-ferrous metals; ARP Plating Brightener & Chemicals. West Coast Licensee—L. H. Butcher Co.

A Timely Message on

"Is Fast Fast Enough?"

by Ben P. Sax

Chairman of the Board, *American Buff Company*

We Americans have long believed in and prided ourselves on our fast pace . . . at our work . . . in our leisure . . . and in our progress to leadership in many fields.

However, all speed is relative. Now it is uncomfortably evident that, like Alice in Wonderland, we must run ever faster than before, merely to stay where we are in relation to the Soviet's amazing record of accomplishment. From a position abysmally low compared to our long-established leadership in all fields, the Soviet's rate of growth has been so fantastic that, unless we immediately and materially increase our pace, her progress will soon outstrip our precarious, yet present security lead.

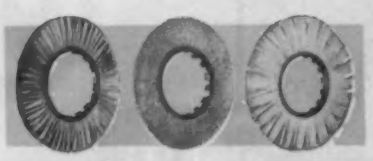
It is up to every one of us to contribute to America's ability to stay ahead, with all the advantages of the liberty which we take so casually for granted. In education, scientific advances, peace and war material; in time, money and personal restrictions if necessary, each must play his part. Speed is of the essence — both in developments in every field, and in our putting them into operation.

Our company's contributions to faster, lower-cost output in the metal finishing industry are augmented by a policy of sharing in the endeavors and sacrifices and responsibilities which every industry, every scientist, student, every citizen must assume and carry in order to retain our priceless heritage and future of liberty.

Sincerely,

Ben P. Sax

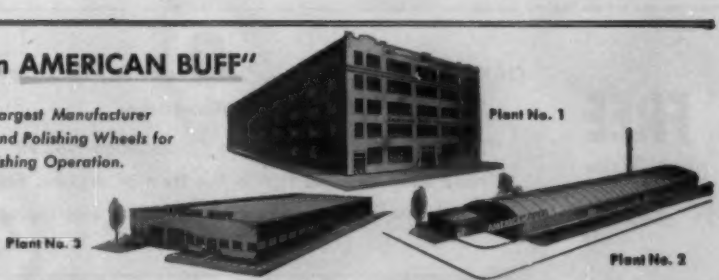
"For the job that's TOUGH—use an AMERICAN BUFF"



BIAS CLOTH • BIAS SISAL • UNIT CLOTH OR SISAL

Patented CENTERLESS Construction
Pat. No. 2,582,506

World's Largest Manufacturer of Buffs and Polishing Wheels for Every Finishing Operation.



American Buff Company
2414 S. La Salle Street Chicago 16, Illinois

AMERICAN BUFFS ARE REGULARLY ADVERTISED IN FORTUNE MAGAZINE

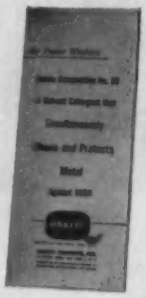
These Oakite shortcuts speed your metal cleaning

1 **Cleaning and rustproofing—*in one washing operation***

Oakite Composition No. 98 (used cold or hot in one-stage or two-stage washing machines) removes cutting oils and chips—while it leaves a thin film that protects steel against rusting between operations or during temporary storage.

Excellent for cleaning before inspection: the metal is cool for immediate handling and the film (too thin to affect measurements) prevents finger prints from corroding highly finished surfaces.

One auto manufacturer uses No. 98 in seven plants for cleaning and rustproofing brake cylinders, camshafts, connecting rods, crankshafts, cylinder heads, flywheels, push rods, tappets, wrist pins, etc.

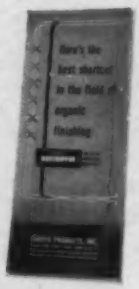


2 **Stripping pigmented paints—*with no need for pickling before repainting***

Oakite Rustripper saves money in paint shops by doing a complete stripping job in one operation. It eliminates extra pickling and neutralizing to remove the metallic pigments, phosphate coatings and rust that prevent successful repainting.

A television manufacturer says "We formerly took 25 minutes to strip rejected cabinets, then had to pickle to remove tarnished phosphate coatings. Today 10 minutes in Rustripper strips the same cabinet so bright and clean you can't tell it from new. Eliminates pickle, neutralize and rinses."

An auto parts maker uses Rustripper for continuous conveyor line stripping. "Cycle of 1 minute and 50 seconds works like a charm stripping paint and incidental rust from rejects and hooks."

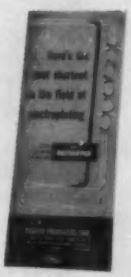


3 **Cleaning, derusting and descaling—*in one alkaline tank***

Oakite Rustripper saves money in plating shops by removing rust or heat scale at the same time it removes oil and other soils. Alkaline pickling with Rustripper avoids hydrogen embrittlement, etching of machined surfaces and other disadvantages of acid pickling. Rustripper is also used for precleaning or electrocleaning in plating lines.

An aircraft manufacturer who formerly sand blasted to remove heat scale says "Now the scale is removed in 30 minutes in a boiling soak in Rustripper."

A job plater who adds Rustripper to his reverse-current cleaner in an automatic plating machine, says "We used to clean 45 seconds. Now 20 seconds cleans sparkling bright . . . saves precious time . . ."



FREE Write for booklets

OAKITE PRODUCTS, INC., 26H Rector St., New York 6, N. Y.

Send me the FREE booklets indicated below:

1. "For Power Washers—Oakite Composition No. 98"
2. "Here's the best shortcut in the field of organic finishing"
3. "Here's the best shortcut in the field of electroplating"

NAME_____

COMPANY_____

ADDRESS_____

Technical Service Representatives in Principal Cities of U. S. and Canada

Export Division
Cable Address: Oakite

OAKITE

(Photo courtesy of Chromium Corporation of America)

Reduce rejects—plate with Mutual low-sulfate chromic acid

When you chromium plate components like these cylinder liners for big diesels you can't risk a reject tag because the job didn't meet specifications.

One form of insurance against plating difficulties is MUTUAL Chromic Acid. Every drum is sampled and analyzed before shipment to make sure that it has a minimum assay of 99.75 per cent CrO_3, and that its sulfate content never exceeds 0.1 per cent.

Rigid quality control in the manufacture of MUTUAL Chromic Acid guarantees the uniformity of the product, making it easier for the plater to accurately control the chromic acid-sulfate ratio of his plating bath.

Mutual Chromium Chemicals

MUTUAL

Sodium Bichromate
Sodium Chromate
Chromic Acid

Potassium Bichromate
Potassium Chromate
Ammonium Bichromate

MUTUAL CHROMIUM CHEMICALS
SOLVAY PROCESS DIVISION
Allied Chemical & Dye Corporation
61 Broadway, New York 6, N. Y.

Allied Chemical

Please send:

☐ Bulletin 52 – Chromium Chemicals – Their History, Properties and Uses.

☐ Bulletin 13 – Anodizing Aluminum by The Chromic Acid Process.

NAME_____ POSITION_____

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P2-8-4

SHAPED, EXTRUDED ANODES

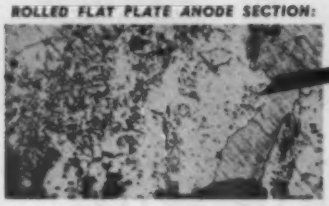
3 STANDARD SHAPES

"RECTANGULAR"

"TEAR DROP"

"DOG BONE"

ROLLED FLAT PLATE ANODE SECTION:



This Photomicrograph shows highly irregular, uncontrolled grain size—a major cause of shedding and resultant rough electrodeposits.

Note small, fully controlled regularity of grain size that promotes uniform corrosion, smoothest electrodeposits, less rejects.

APW EXTRUDED ANODE SECTION:

THE GREATEST ANODE DEVELOPMENT IN YEARS

APW Shaped, Extruded Anodes were developed to extend the useful life of our anodes . . . to assure uniform and consistently smooth electrodeposits . . . to minimize shedding. They accomplish these objectives for our customers day after day—and in addition, *they have helped to lower plating costs!*

The anodes are scientifically shaped to retain 80% *after 85% by weight has been plated* . . . prea . . . zed polarization and le . . .

The . . . en definite . . . its are a c . . .

Be cer . . .

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THE AMERIC . . .

231 NEW JERSEY RAILR . . . NEW JERSEY

ENGELA . . . DUSTRIES

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WILL HENCEFORTH BE DESIGNATED AS

ENGELHARD INDUSTRIES, INC.

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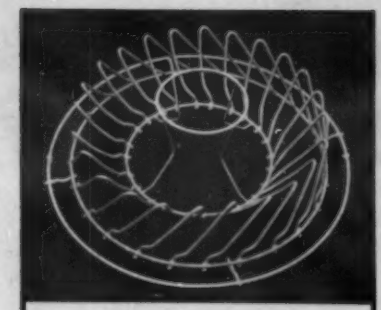

COLD DIP COATINGS

Looking for a plastisol to give you heavy, uniform coatings without preheating your product before dipping?

Then look to Reynosol—America's fastest growing plastisol for cold-dips. Products such as dish drain baskets, gloves, boots, cable, wire—in fact any product of metal, fabric, wood or paper can be successfully cold dipped with Reynosol.

COLOR	UNLIMITED
WEIGHT	SP. GR. = 1.20
FIRE HAZARD	LITTLE OR NONE
% FILM FORMING	95% to 100%
VISCOSITY	10,000 TO 15,000 CPS.
AGING PROPERTIES	GOOD
COLD PROPERTIES	FLEXIBLE AT 65° F
LIGHT RESISTANCE	GOOD
TYPE OF SURFACE	DRY AND GLOSSY
TENSILE STRENGTH	VERY GOOD
SCUFF RESISTANCE	VERY GOOD
ABRASION RESISTANCE	VERY GOOD
ALKALI RESISTANCE	VERY GOOD
ACID RESISTANCE	VERY GOOD
OIL RESISTANCE	VERY GOOD
HARDNESS	AS HIGH AS 80 (SHORE-A)
COST PER .001 INCH THICKNESS	APPX. $.034 SQ. YD.

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REYNOLDS CHEMICAL PRODUCTS COMPANY

ANN ARBOR, MICHIGAN

DIVISION OF STUDNITZ GREENE CORP.

Plated under vacuum, these articles have a high-sheen surface that lasts as long as conventionally plated pieces.

Why plating **with vacuum** *is easier and more profitable*

Without buffing or polishing, without corrosive cleaning baths, without highly skilled help, you can now cover articles like those shown above with a shimmering finish that lasts for years.

All it takes is a CEC vacuum coater and some inexpensive lacquers to make metal and plastic articles look silver, gold, copper, or a multitude of other colors and tones.

Vacuum-plating costs less. With a CEC vacuum coater you can plate thousands of pieces per day with unskilled labor.

New longer-lasting lacquers. There are on the market many lacquers which can make vacuum-plated articles wear as well as those plated in conventional ways.

The stayfast finish requires no retouching, or buffing, or polishing—just an easily applied coat of lacquer.

You can control film thickness easily and precisely. You can make surfaces electrically conductive *or* insulating as you wish.

For further information on this highly profitable process, write for information on the coaters, the lacquers, and the methods used.

1450 2½" diameter pieces per cycle, 3 to 6 cycles an hour—that's the production rate of this 48" CEC vacuum coater.

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SALES AND SERVICE OFFICES IN PRINCIPAL CITIES

HOST: AES
INDIANAPOLIS BRANCH

INTERIM MEETING REPORTER

HOTEL MAROTT
INDIANAPOLIS, IND.
JANUARY 11, 1958

INDIANAPOLIS ASSEMBLY PAVES WAY FOR CINCINNATI ANNUAL MEETING

DELEGATES REPRESENTING 24 Branches of the American Electroplaters' Society (AES) participated in the fruitful Fifth Annual Meeting of the Supreme Society held at the Marott Hotel in Indianapolis, Saturday, January 11 with the dynamic Indianapolis Branch as Host Branch. Adjudged one of the most effective winter assemblies of the AES's summit governing council yet conducted since Interim Meeting inception in 1951, it also provided meeting opportunity for such AES committees as the Membership Committee and the Structure of the Society Committee.

Branch President Bert Hawhee opened the Interim Meeting with a warm welcome to convened Delegates, then turned the chair to National President Francis T. Eddy who made the opening remarks then presided during the meeting. Officially represented were the following 24 of the AES's 57 Branches:

Baltimore-Washington	Milwaukee
Boston	Newark
Buffalo	New York
Chicago	Philadelphia
Cincinnati	Rockford
Cleveland	Southeastern
Columbus	St. Joseph Valley
Dayton	St. Louis
Detroit	Syracuse
Grand Rapids	Toronto
Indianapolis	Waterbury
Kansas City	Western Ontario

Officers Share in Mirroring AES Affairs

From National officers, the convened Delegates received a concise, complete summary of the Society's current status and policy affairs. The President himself discussed finances. First Vice President Herberth E. Head reported on the education program; Second Vice President Ralph D. Wysong highlighted the membership program; Third Vice President W. Andrew Wesley covered necessary Constitutional and Bylaws Amendments now referred or being referred to accredited Delegates of all Branches for consideration and action by Letter Ballot.

National Executive Secretary John P. Nichols reported on National Headquarters affairs and PLATING and other publishing activities, and Ezra Blount, Co-Chairman of the 45th Annual Convention brought the meeting an interesting report on the AES's coming Cincinnati Convention. Rodney Leeds, PLATING editor, covered the status of technical papers on hand or under preparation for PLATING publication.

Past President Samuel Heiman discussed the new "AES Scientific Achievement Award" and introduced the newly elected Chairman of the Scientific Achievement Award Committee, namely Dr. Russel E. Harr of Chicago, who supplemented Dr. Heiman's remarks.

Structure of Society Committee Proposal Favored

Besides other Committee reports, the meeting heard the report of the current Structure of the Society Committee appointed by the Executive Board last summer by Supreme Society direction, then adopted the following "sense of the meeting" resolution to be offered for Supreme Society consideration and action at the Annual Meeting in Cincinnati, May 22, 1958:

> "Be it resolved that the AES Executive Board, at its discretion or when so instructed by the Delegates of the Supreme Society, shall appoint an Advisory Committee composed of five members. The function of this Committee shall be to study such problems as are assigned to it by the Executive Board, or by the Executive Board at the direction of the Supreme Society, and submit a report to the Executive Board. The Committee shall be appointed for one year, or until it completes the specific project for which it was appointed."

For Annual Meeting consideration, it also adopted the following by the Law Committee as reported by Manson Glover, that Committee's Chairman:

> "Your Committee recommends that due steps be taken to offer to the Annual Meeting at Cincinnati, an amendment to the Bylaws of the Society, Part I, Article VI, Section 5 to strike out the words, 'Robert's Rules of Order' and substitute the words, 'Cavanaugh's Simplified Parliamentary Practice'."

Branch Fiscal Year Transition Committee Report Passes

The meeting heard from National Officers regarding plans to meet fiscal year adjustment problems momentarily facing AES as the result of transition to the Society's new fiscal year, namely July 1–June 30 (from April 1–March 31). These include the following upon which Supreme Society action is being sought via letter ballot since the Interim Meeting itself is powerless to legislate:

a) Routine changes in sections of the Bylaws collateral to those sections

BUSY DAIS AT FIFTH INTERIM MEETING

The busy dais at the Fifth Interim Meeting. Left to right: Third Vice President Wesley; First Vice President Head; National President Eddy; National Executive Secretary Nichols; Branch President Hawhee; Past President Heiman; Second Vice President Wysong. In foreground, Mrs. Florence K. Marquardt, the AES's official reporter.

INDIANAPOLIS ASSEMBLY SPEAKER

Speaker at the Indianapolis Branch's meeting on the eve of the Fifth Interim Meeting was Dr. R. C. Gibson of the Parker Rust Proof Co. He addressed the large assembly on "Phosphate Coating on Metal Surfaces."

BRANCH DINNER FOR SUPREME SOCIETY DELEGATES

An Indianapolis Branch dinner preceded the Branch Meeting held at the Marott Hotel, Indianapolis, on the eve of the Fifth Interim Meeting. Above, a view of that successful event attended by a large number of visiting Delegates.

affecting the fiscal year amended by the Supreme Society in Montreal last June.

b) Authority for National Headquarters to bill Branches for 15 months (April 1, 1958 through June 30, 1959) per capita taxes and for Branches, in turn, to bill Branch members for 15 months per capita taxes (for same period) thereby enabling the Society to adjust itself to its new fiscal year.

The procedure embodying the foregoing was conceived and recommended to the Executive Board by a special committee of experienced Branch Secretaries appointed by President Eddy for that purpose headed by Dr. D. Gardner Foulke (Newark) Chairman; Ward W. Kelly (St. Louis); Edward J. Kubis (Detroit); I. William Marcovitch (Philadelphia) and Robert G. Parker (Bridgeport). The Committee's report was approved by the Executive Board. The Interim Meeting, by "sense of the meeting" resolution, unanimously followed suit.

It also adopted a "sense of the meeting" resolution approving the Interim Society/PLATING Budget (April 1, 1958–June 30, 1958) now channeled to all accredited Delegates composing the Supreme Society for immediate consideration and action via Letter Ballot.

Candidacies of Cavanaugh and Borlet Announced

Announced at the Interim Meeting were the candidacies of George W. Cavanaugh of the Syracuse Branch and Chester G. Borlet of the Grand Rapids Branch for the AES Third Vice Presidency. Nominations and election to that post will take place at the Supreme Society's Annual Meeting.

On a sadder note, the Interim Meeting dispatched a telegram of regret and hearty best wishes for full recovery to Past President Franklyn J. MacStoker, seriously ill. It also adopted a memorial resolution of sorrow over the recent death of Past President Clarence L. Van Derau.

The Executive Board itself had met in full day's resultful meeting on Friday, January 10 and continued its sessions Saturday night, January 11. Among much business transacted, it approved the Bylaws of the new Membership Committee and the new Educational Committee and finalized the new John J. Hanney Memorial Award with the Grand Rapids Branch.

Indianapolis Branch Lauded for Effective Service

The Indianapolis Branch held a Branch dinner Friday evening attended by National Officers and visiting Delegates. It was followed by an interesting Branch Meeting. The evening's speaker was Dr. R. C. Gibson of the Parker Rust Proof Company who discussed "Phosphate Coating on Metal Surfaces." The Interim Meeting itself concluded on Saturday evening with a cocktail party for assembled Delegates and the Indianapolis Committee.

High tribute for effective service as Host Branch was paid to the Indianapolis Branch by a Resolution drafted by Manson Glover, Chairman of the Law Committee, unanimously and enthusiastically adopted by the Assembly. The Committee was headed by M. L. Whitehurst, General Chairman, and included M. Lester Reynolds, Reservations and Housing; Edward Bruck, Registration; Quentin Shockley, Branch Dinner and Interim Meeting Luncheon; Elmer Sundberg, Equipment and Notices; Roman Bender, Cocktail Party; John Holland, Finance, and Edna Rohrabaugh.

INTERIM MEETING STALWARTS OF HOST BRANCH

Some of the Indianapolis Branch stalwarts who provided effective setting and facilities for the Fifth Interim Meeting. Left to right: Marshall L. Whitehurst, General Chairman; Bert Hawhee, Branch President; M. Lester Reynolds, Reservations and Housing; John Holland, Finance; Edna Rohrabough, Executive Assistant; Edward Bruck, Registration and Quentin Shockley, Branch Dinner and Interim Meeting Luncheon. Roman Bender, Cocktail Party, was not present when picture was taken.

DELEGATES AT FIFTH INTERIM MEETING

An early morning view of the assembly of Delegates composing the Supreme Society at that governing council's Fifth Interim Meeting, held in Indianapolis, January 11.

AES RESEARCH CONFERENCE AT NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C.

(Top left) Dr. A. V. Astin, director of the National Bureau of Standards, welcomes the AES Research Conference. (Top center) Chemistry Building of the NBS in which the conference was held. (Top right) Dr. W. Andrew Wesley, AES third vice president, responds to the welcome. (Center left) The Conference Committee, left to right, August Mendizza, Clarence H. Sample, Dr. William Blum, chairman, and Fielding Ogburn, secretary. (Center right) The Research Conference in session. (Bottom left) Three of the Session Chairmen: Dr. Abner Brenner, Robert A. Ehrhardt and Dr. William Blum. (Bottom right) Cocktail Party at the Caribar Room of the Sheraton-Park Hotel following the conference.

Research Program Holds Fruitful Two-Day Washington Conference

by Fielding Ogburn

A full two-day conference of the research organization of the American Electroplaters' Society (AES) was held December 10 and 11. Forty people attended the highly successful meetings held at the National Bureau of Standards in Washington.

During the two days, each of the seven active projects were reported on by the respective Project Directors. Following

each report, up to 45 minutes were used for general discussion of the report, and these discussion periods were usually very lively.

Blum Presides at First Session

The first session, presided over by Dr. William Blum, started with the welcoming remarks of Dr. A. V. Astin, Director of the National Bureau of Standards. Dr. W. Andrew Wesley, AES third vice president, responded in behalf of the AES and the meeting then settled down to the business at hand. Henry Linford and Walter L. Pinner shared the spotlight in the morning. Dr. Linford of Columbia University reported on The Cleaning and Preparation of Metals for Electroplating (Project 12) and Mr. Pinner covered the project on Accelerated Corrosion Tests for the Performance of Plated Coatings (Project 15).

Ehrhardt, Brenner, DuRose Chairman Sessions

Research Committee Chairman Robert A. Ehrhardt chaired the Tuesday afternoon session at which Dr. M. H. Jones of the Ontario Research Foundation discussed the Influence of the Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating (Project 14). Fielding Ogburn followed this with a review of his work on the Nature, Cause and Effect of Porosity in Electrodeposits (Project 13).

Wednesday morning, Dr. Abner Brenner served as Sessions Chairman. He introduced Dr. Edward Wichers, chief of the Chemistry Division of the National Bureau of Standards, and then called on Dr. J. O'M. Bockris to summarize his work on the Mechanism of Electrodeposition (Project 16). Dr. Bockris' report drew the close attention of all present as one had to be on his toes to keep up with theoretical concepts. Henry Leidheiser of the Virginia Institute for Scientific Research reported on Project 17, Microthrowing Power.

The final session was headed by Arthur H. DuRose. He called first on William Geissman of the National Lock Company, who indicated the plans for the Society's youngest project, Project 18, Mechanical Finishing of Metal Surfaces. To conclude the program, Dr. Blum led a general discussion of the kinds of projects the Research Committee should consider for the future and the scope of the Committee's program.

To break up the work with a little play, a cocktail party was held at the end of the first day at the Sheraton Park Hotel, courtesy of the International Nickel Company (INCO). When all of the participants had become acquainted with each other, Walter Prine of INCO gave a short summary of the nickel supply situation and showed a very interesting film on The Refining of Nickel. The climax of the evening was a dinner planned by the arrangements committee and an exchange of jokes between Myron Diggin and Dr. Blum.

Participating in the discussions of each session were the AES Project fellows who do all the laboratory work for the program. J. Desmond (Project 12), D. W. Ernst (Project 13), J. Zajdowski (Project 14), Michio Enyo (Project 16) and Mrs. Lucy Garmon (Project 17). Kenneth Gatchel (Project 18) did not attend the conference.

Arrangements for the Research Conference were made by the Project 13 Subcommittee, consisting of Dr. William Blum, Clarence H. Sample and August Mendizza—assisted by Fielding Ogburn, Dr. Abner Brenner and Dr. Donald Ernst.

The 1957-1958 Research Program will be Highlighted in the April Issue

FOR FAST, ECONOMICAL BUFFING AND POLISHING—

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GREASELESS COMPOUNDS

NEW PLASTIC CONTAINER—
ELIMINATES COMPOUND WASTE
REDUCES APPLICATION TIME

Here's a new waterproof plastic container for Atlantic Greaseless Compounds that saves time and money on buffing and polishing operations. Now, there is no need for operator to spend time stripping away cover . . . plastic container wears away as stick is applied to spinning buff. And, costly waste is reduced since container exposes only the compound that is in contact with the buff. Standard aluminum tube and foil-lined fibre board container available if desired.

Atlantic Compound combines continuous research, high grade materials and rigid quality control of manufacturing to assure you of a product with extremely high uniformity.

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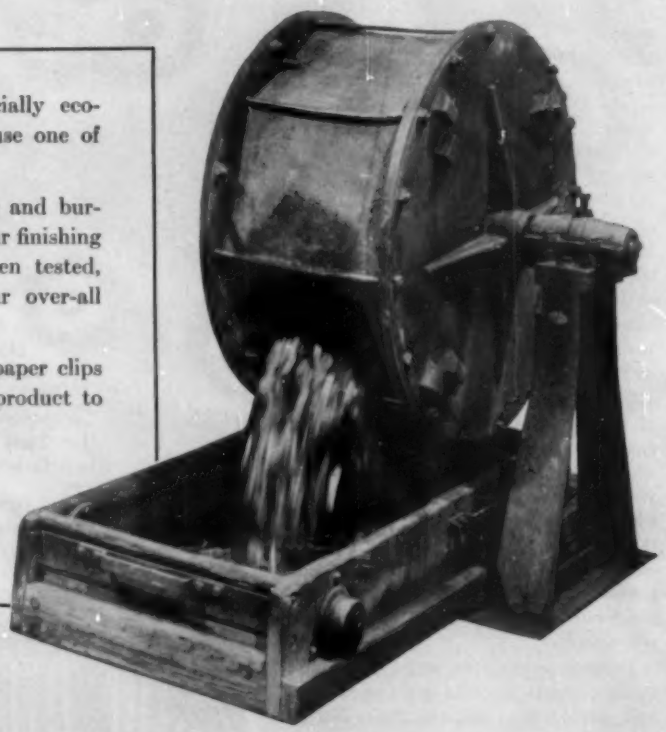
You see, Wyandotte produces de-burring and burnishing compounds to cover all phases of your finishing operations. Each of these products has been tested, proven in operation; each will lower your over-all costs through low use-costs.

Whatever your finishing problem—from paper clips to zinc die castings—there's a Wyandotte product to solve it—efficiently, economically. Why not call your Wyandotte representative today. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California. Offices in principal cities.*



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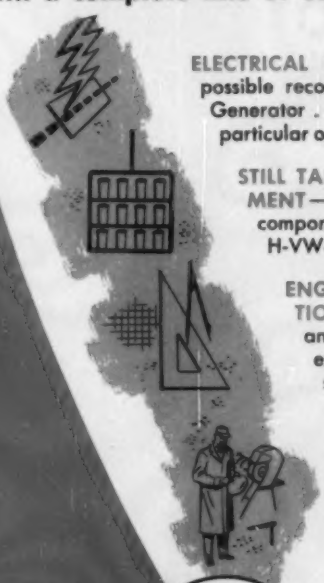
No matter what your aluminum finishing problem or need, you'll find the answer at H-VW-M . . . because it is the one company combining a complete engineering service with a complete line of equipment and supplies!



ELECTRICAL EQUIPMENT — Want the best possible recommendation of a Rectifier . . . Generator . . . or Control Equipment for your particular operations? Page 2 tells how to get it.

STILL TANK OR FULL AUTOMATIC EQUIPMENT — Whatever your need — from a single component to a complete, integrated system — H-VW-M supplies it . . . Page 3.

ENGINEERING SERVICE AND INSTALLATION — H-VW-M engineers and technicians are anodizing equipment specialists, with years of experience. Page 3 tells why these H-VW-M services mean greater efficiency and savings in your plant.

ALUMINUM FINISHING SUPPLIES — Page 4 shows how H-VW-M research has resulted in new compounds, improved buffs and cleaners to make aluminum finishing easier, better.

HANSON-VAN WINKLE-MUNNING COMPANY
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Manufacturers of a complete line of electroplating and polishing processes, equipment and supplies

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These H-VW-M Anodizing and Finishing to New Savings, New Efficiency, New

ELECTRICAL EQUIPMENT

H-VW-M is the only manufacturer of both Germanium and Selenium Rectifiers *and* low voltage, direct current Motor Generator Sets for the metal finishing industry. This thorough experience in every phase of low voltage power generation and rectification means that when you bring your power problems to H-VW-M you're sure to get the perfect equipment recommendation.

Self-Contained Rectifier with Tap Switch Control

Remote Controlled Rectifier with Tap Switch Control

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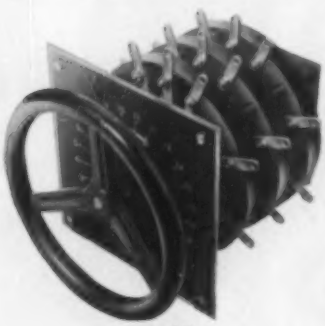
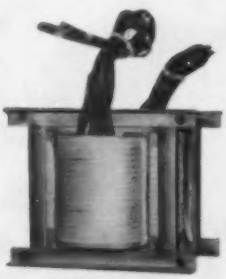
Highest quality and efficiency, flexibility, economy and low maintenance are the characteristics combined in H-VW-M's full line of both Germanium and Selenium Rectifiers. 6 to 48 volt units—both remote and self-contained—provide the exact direct current low-voltage and high amperage required in aluminum anodizing. The widest possible choice of controls and control combinations is available. Such devices as manual or motor operated tap switch controls, continuously variable auto-transformers and saturable core reactors are used with or without supplemental controls to provide automatic voltage stabilization, automatic constant current as well as automatic programming.

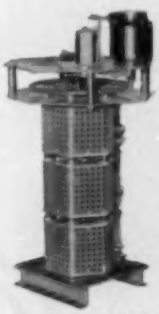
Write for Bulletin ER-108, which gives further information about Rectifiers and Controls, plus useful control application suggestions.



Manual Tap Switch Control



Saturable Core Reactor



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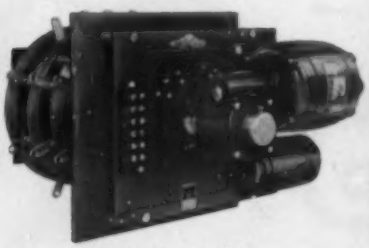

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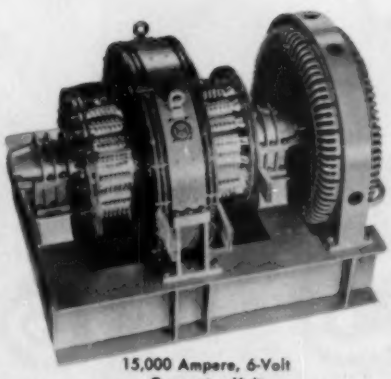
H-VW-M Motor Generators designed especially for metal finishing operations are built in sizes up to 50,000 amperes, and accessory equipment includes a full line of controls and control panels to cover any desired control function. Easy-to-maintain H-VW-M Motor Generators have exceptionally rugged and practical construction features insuring maximum performance and life. Standard voltage ratings range from 6 to 50 volts, and include the 18 and 24 volt units usually required for sulphuric acid anodizing, plus the 40 and 50 volt units used in chromic acid anodizing. Write today for 24-page Bulletin G-104, covering in detail all H-VW-M Generators.



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Automatic Anodizing Control Panel

Supplies, Equipment and Services Add Up Simplicity of Operation in Your Plant

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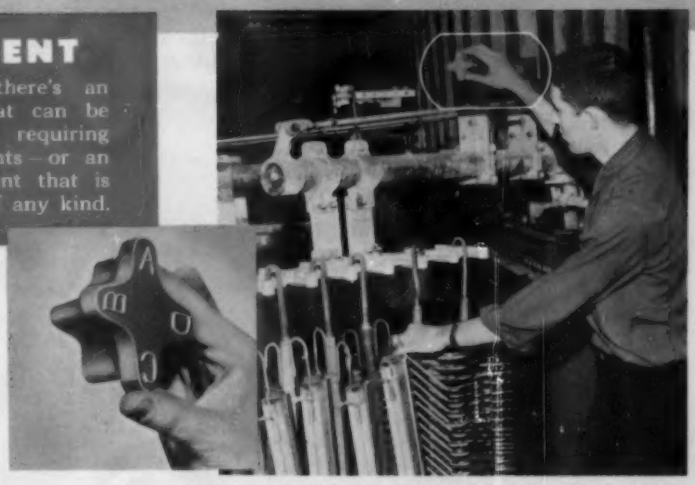

Workman "dials" desired cycle in refrigerator plant. Parts will by-pass or lower into baths as dial setting dictates.

Automation in Metalfinishing— *Full Automatic Conveyors with Dial-A-Cycle*

H-VW-M's new DIAL-A-CYCLE system automates nine or more complete metalfinishing processes on a single anodizing or electroplating machine. This revolutionary by-pass mechanism can be used on any metalfinishing installation for anodizing, electroplating, or similar processing. It is especially useful and effects substantial cost reductions when a variety of parts requires several different processes or colors.

DIAL-A-CYCLE, as the name implies, is controlled by a simple dial setting. The dial is mounted on the carrier arm that carries the parts through processing tanks. It is set by the machine operator for the processing steps through which each load of unfinished parts is to move. Automatic conveying then takes over, lowering the parts into the required tanks and bypassing others.

Different products, requiring different anodizing cycles, may be processed at the same time, with the same equipment. DIAL-A-CYCLE gives you new versatility while reducing operating, labor, and maintenance costs. Close, automatic control of transfer and immersion periods improves quality.

DIAL-A-CYCLE is the newest of many types of conveyors and equipment H-VW-M supplies to aluminum finishers. H-VW-M also design, manufactures, and installs return-type conveyors . . . elevator conveyors . . . straight-line conveyors . . . and others. For a complete description of all types, write for Bulletin FA-105.

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And H-VW-M's Engineering and Installation Service

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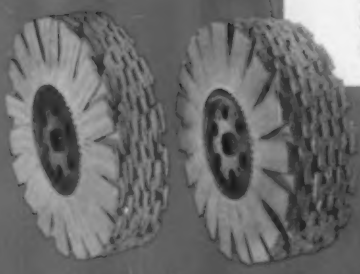

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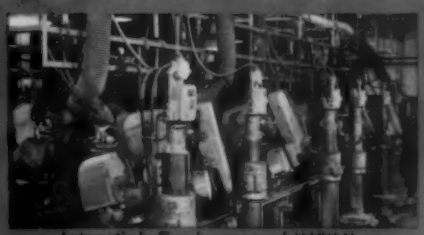

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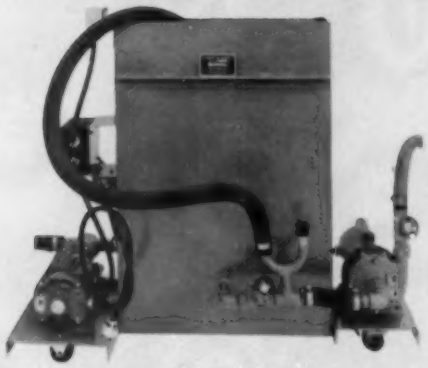

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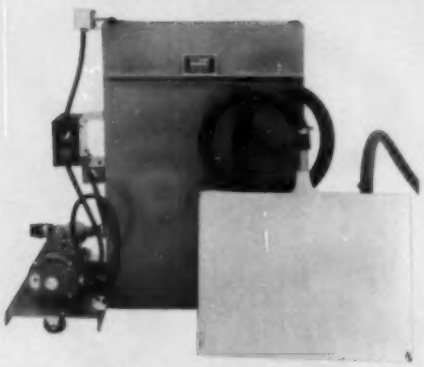

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ANTIMONY PLATING ON STEEL AND ZINC

by G. R. SCHAER, W. H. SAFRANEK and C. L. FAUST*

A method was developed for plating antimony more adherently on steel by pretreating the steel anodically in phosphoric and other acid solutions. This treatment was helpful in reducing porosity in antimony and other electroplates on steel. Antimony-plated steel was superior to zinc-plated steel in resisting corrosion in salt spray fog and in air saturated with water vapor. No bulky corrosion products were formed on the antimony plate. Outdoor exposure has not yet been definitive but is being continued.

Blistering observed on antimony-plated zinc die castings was a result of the formation of weak, brittle alloys by diffusion between antimony and zinc or between antimony and copper plate. However, thinner coatings of antimony applied directly on zinc by immersion not only did not blister during exposure outdoors for one year, but also appeared to be protecting the die castings from corrosion.

INTRODUCTION

DESPITE THE INTEREST in antimony plating revealed by a number of articles and patents on the subject, no known commercial applications have been developed. Yet, the resistance of cast antimony to attack by many corrosive agents and to atmospheric attack indicated that antimony electroplate might have applications as a protective coating. Another incentive at the time this program was started was the limited availability of nickel for electroplating and the need, therefore, for another type of electroplate.

M. C. Bloom[1] found that ground antimony metal had no appreciable attack in 0.1 N solutions of sodium chloride, hydrochloric acid, nitric acid, perchloric acid, sulfuric acid and ammonium hydroxide. However, organic acids such as tartaric and oxalic, and caustic solutions containing hydrogen peroxide rapidly dissolve antimony. Salt spray tests on antimony-plated steel indicated that protection similar to that of nickel-chromium coatings could be obtained.[2] Other investigators have reported semi-bright and bright antimony plating baths.[2, 3, 4, 5, 6] All except one of these methods required an initial strike plate such as copper, lead, tin, or silver. The one method[1] for plating antimony directly on steel required an etching or roughening step before plating.

Chromium plating over antimony was the subject of two patent disclosures. One method[7] included a nickel strike before chromium plating. The other method[8] revealed a technique for obtaining a bright chromium plate in a chromic acid bath directly on antimony.

Most of the published work has been directed toward decorative applications. Apparently little attention was given to considering antimony for its protective qualities in nondecorative uses. Therefore, one objective of our research was to evaluate the corrosion resistance of antimony-plated steel and zinc die castings. Antimony might offer protection to steel for uses where zinc has the disadvantage of forming bulky, sticky white-corrosion products. This possibility was examined by exposing antimony-plated and zinc-plated panels for direct comparison.

Published data also appear to neglect the inherent brittleness of antimony and its low tensile strength. Any thought of using antimony as an electroplated coating must face the possible detriment of its apparently inherent brittleness. Such a property would become important if it were the only factor preventing successful use of antimony as a protective coating. However, brittleness might not be a handicap on a nonflexed material such as a zinc die casting or as a thin coating on steel items of relatively rigid design.

Antimony might cost slightly more to plate than zinc. Although antimony metal costs about three times as much as zinc per unit weight, the power consumed for depositing antimony is only about one-half to two-thirds as much as the power consumed for plating an equal thickness of zinc. The antimony plating bath used in this work had better throwing power than the zinc bath and therefore required less metal for a given minimum thickness. The throwing power was not as good as that of cyanide zinc solutions. However, the antimony bath operated at nearly 100 per cent cathode efficiency which would require less electrical power than the less efficient zinc cyanide solutions. These cost factors for plating antimony and zinc approximately offset each other unless electrical power costs are very low.

PRELIMINARY PLATING STUDIES

The characteristics of the citrate bath[2] appeared to be superior to the characteristics of the chloride[9] and fluoride baths[1] when they were compared in a preliminary study. The citrate solution could be operated without venting, and its electroplates did not exhibit the explosive prop-

*Battelle Memorial Institute, Columbus, Ohio.

◀ INDICATE B 203.

erty associated with electroplates obtained in the chloride bath. Both the chloride and the fluoride baths required venting to carry off the toxic acid fumes. Because of its superior characteristics, the citrate bath was selected for plating antimony on steel panels and zinc die castings that subsequently were evaluated for corrosion resistance.

Of course, the electroplates produced in the citrate bath were not bright. At the time this research was undertaken, the methods for plating bright antimony[3, 4, 5, 6] had not been published.

The citrate bath composition[2] and operating conditions were as follows:

Potassium citrate ($K_3C_6H_5O_7 \cdot H_2O$)	145 g/l
Citric acid ($H_3C_6O_7 \cdot H_2O$)	185 g/l
Antimony oxide (Sb_2O_3)	60 g/l
*p*H	3.5 to 3.7
Temperature	130F
Current Density	26 amp/sq ft
Agitation	Work rod oscillation (1½ in.; 17 strokes/min
Anodes	Cast antimony
Plating rate	0.000035 in./min

PLATING ON STEEL

Early in the experimental program, a need arose for improving the adherence and covering power of antimony plate on steel. Poor adherence appeared to be due to immersion antimony plate by chemical displacement on steel, according to observations on this project and by others.[2] To correct this situation, anodic passivation was investigated. Such pretreatment in phosphoric acid, sulfuric acid or hydrochloric acid apparently prevented antimony from immersion plating in this citrate bath. Cathodic current in the plating bath depassivated the steel surface and deposited antimony.[10]

The acid pretreatment involved a high enough anodic potential to passivate the steel and liberate oxygen. Without such polarization, adherent plates were not obtained. Phosphoric acid appeared best for accomplishing the anodic treatment. In hydrochloric acid, which passivates steel anodes relatively slowly, only the high current density areas on a test panel were polarized after 30 seconds of treatment. After plating this panel with antimony, the plate on the polarized area was adherent, whereas the plate on the low current density area was less adherent. Furthermore, the deposit on the high current density area was continuous and pore free, whereas the deposit on the low current density area was not.

Bending the panels indicated that the antimony plate was adherent. However, the plate appeared more brittle than some bright nickels.

When steel was plated without first passivating it anodically, bare areas remained uncovered with antimony. This situation indicated a nonuniform condition, such that antimony preferably deposited on areas initially covered with antimony, while no plate deposited on the other areas. When the steel surface was made more uniform by plating it with iron,[11] antimony plate thereafter was continuous and adherent. Immersion plating of antimony on the electrolytic iron plate was not observed after about five seconds immersion in the citrate plating bath.

Thus, two procedures were found for plating antimony adherently on steel:

(1) Pretreatment by anodic passivation in acid electrolyte
(2) Iron strike plate

PREPARATION OF EXPOSURE TEST PANELS

Exposure test panels of S.A.E. 1020 steel, 0.010 by 4 by 6 inches were plated in a 10-liter bath. The steel panels with the as-rolled bright finish were processed as follows:

(1) Cleaned anodically in a proprietary alkaline cleaner* for steel
(2) Rinsed and pickled for one minute in hydrochloric acid solution (sp gr 1.12), room temperature
(3) Rinsed and treated anodically for one minute in phosphoric acid solution (sp gr 1.69) at 45 amp/sq ft at 60 to 70F
(4) Rinsed and plated with antimony.

For comparison purposes, other panels were plated with zinc. The zinc bath composition and operating conditions were as follows:

Zinc sulfate ($ZnSO_4 \cdot 7H_2O$)	360 g/l
Sodium acetate ($NaC_2H_3O_2 \cdot 3H_2O$)	15 g/l
Ammonium chloride (NH_4Cl)	30 g/l
Glycyrrhiza (Extract, U.S.P.)	0.5 g/l
*p*H	4.0–4.2
Current Density	30 amp/sq ft

Three sets of zinc plated panels were prepared, including:

(a) Set A, plated with zinc after conventional anodic cleaning and acid dipping
(b) Set B, plated with zinc after anodic cleaning, acid dipping and anodic treating in phosphoric acid solution
(c) Set C, treated by the Cronak process[12] to apply a protective chromate conversion coating after zinc plating.

Three plate thicknesses (nominal) were selected for the exposure test panels, including:

(a) 0.00015 in. (0.15 mil)
(b) 0.0005 in. (0.5 mil)
(c) 0.001 in. (1.0 mil)

The edges of all panels were shielded with plastic frames to prevent excessive edge build up. With these shields, the antimony plate was more uniform in thickness than the zinc plate. The thickness of antimony plate at the center of each panel was about 90 per cent of its average thickness, whereas the thickness of zinc plate at the center of each panel was only about 80 per cent of its average thickness.

PROTECTIVE VALUE OF ANTIMONY ELECTROPLATE ON STEEL

The results of comparing the protective value of antimony with zinc electroplates on steel are summarized in Table I. The antimony plate appeared superior to the zinc plate in resisting corrosion in salt spray fog and in air (at 110F) saturated with water vapor. The antimony plate was discolored slightly, but the zinc plate on panels not treated in chromate solution was covered with bulky white corrosion products. Zinc plate only 0.00015-in. thick was almost consumed by sacrificial corrosion but the same thickness of antimony was still protecting the steel, except for a few pinpoints where rusting was observed. The chromate coatings on the zinc-plated, Set C panels, were bleached completely in the humidity cabinet and slightly in the salt spray cabinet.

Both antimony and zinc-plated panels were stained as a result of outdoor exposure. A mixture of red-rust and blue stain was observed on the antimony whereas a dark gray stain was observed on the zinc plate. Treating the steel anodically in phosphoric acid solution prior to zinc plating

*Anodex, product of MacDermid, Inc.

did not affect the results of the exposure tests. The outdoor exposure program is being continued with the objective of reaching a more definitive position.

PLATING ON ZINC DIE CASTINGS

The research on plating antimony on zinc die castings was initiated when nickel was in short supply to metal finishers. Three methods were compared for plating antimony on die castings:

(1) Direct plating
(2) Plating on copper strike
(3) Plating on a zinc strike

In contrast to plating on steel, no adhesion problem was encountered when antimony was plated on zinc or copper. Immersion plating on zinc appeared to take place, judging by the dark appearance of the plates deposited during the first few seconds of electroplating and the bright appearance of the plate deposited thereafter. Despite this evidence for immersion plating, no bond failure could be detected by scraping, filing, or hammering.

The zinc strike plate on zinc castings improved the quality of the subsequent antimony in that there were consistently fewer pits in the plate associated with pores in the castings. The zinc plate apparently covered such defects.

Outdoor exposure for one year showed that 1.25 mil antimony plus a thin chromium plate had protected the die castings about as well as 0.3 mil copper-1.25 mil nickel-chromium plate on die castings that were exposed simultaneously for comparison purposes. However, the details of this program are not given here because the usefulness of antimony plate on zinc die castings became questionable as a result of the research on the diffusion characteristics of the antimony plate.

Because this work was done before bright antimony plating was accomplished, the plates were buffed for subsequent chromium plating. Such buffing often caused the antimony plate to blister and flake off the die casting. The heat of buffing caused diffusion-alloying at the zinc-antimony interface. The alloy layer was brittle and weak. Such detrimental diffusion also occurred during one year of storage at room temperature, when the antimony plate was not buffed.

Figs. 1 and 2 show cross sections of antimony plates directly on a zinc die casting and on a copper-strike-plated zinc die casting, and reveal the diffusion-alloy zones. The brittle alloy layer formed with the copper was previously reported.[11] As another example of diffusion alloying, heating unbuffed antimony plate on a zinc die casting for 48 hours at 320F, resulted in flaking.

TABLE I

RESULTS OF COMPARING ANTIMONY WITH ZINC ELECTROPLATES[a] ON STEEL IN SEVERAL CORROSION TESTS

Corrosion Test	Duration of Test	Appearance of Antimony-Plated Steel Panels	Appearance of Zinc-Plated Steel Panels	
			With Chromate Coating	Without Chromate Coating
Humidity Test at 110 F[b]	Two months	Few pinpoints of rust; nonuniform thin blue stain	Nonuniformly bleached; no white corrosion products or rust	Thick, white-corrosion products on all panels; panels with 0.15 mil plate were badly rusted, but other panels with thicker plate were rust free
Salt Spray Test[c]	Seven hours	Nonuniform thin blue stain; panels with 0.15 mil plate had many small rust spots; other panels with thicker plate were rust free except on edges	Slightly, but nonuniformly bleached; no white corrosion products or rust	Thick, white-corrosion products on all panels; panels with 0.15 mil plate showed very many large rust spots; other panels with thicker plate were rust free
Outdoor Exposure[d]	Two months (March and April, 1956)	Coated with red-rust and blue stain	Slightly, but nonuniformly bleached; no white corrosion products or rust	Nonuniform dark stain; no rusting
Indoor Exposure[e]	One year	No evidence of corrosion	No evidence of corrosion	No evidence of corrosion

(a) The antimony and zinc plates were 0.15, 0.5 or 1.0 mil in thickness.
(b) Humidity test was in air at 110F saturated with water vapor. The panels had water condensed on the surface.
(c) Salt spray test was conducted according to ASTM Designation: B-117-49T.
(d) Outdoor exposure was in Columbus, Ohio during February and March.
(e) Indoor exposure was in the Battelle Laboratories in Columbus, Ohio. Bare steel panels exposed at the same time were completely rust covered after two weeks of exposure.

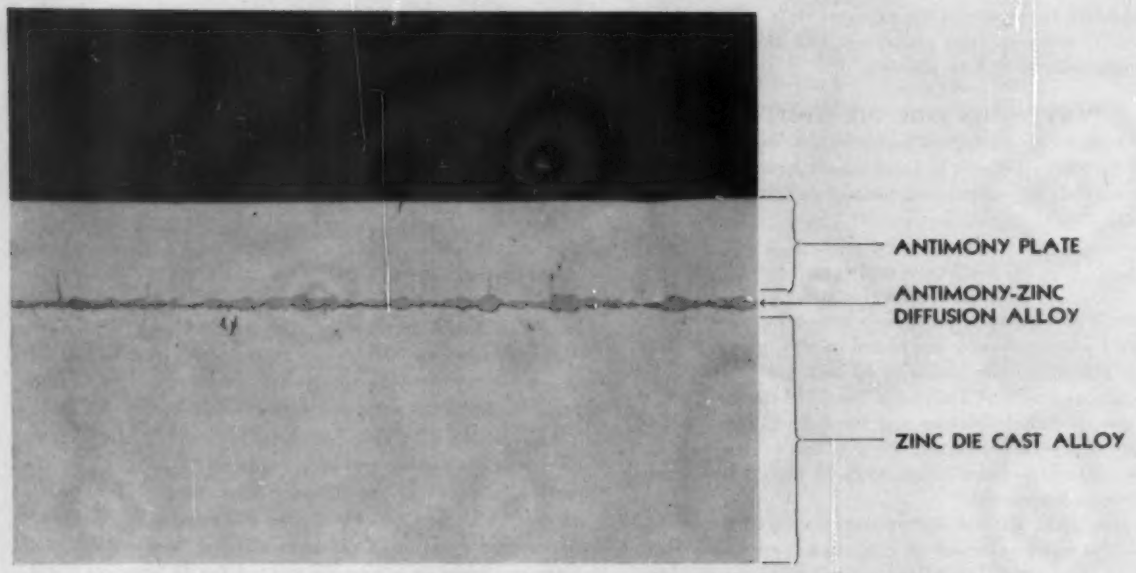

Fig. 1. Buffed antimony plate on zinc die casting showing zinc-antimony diffusion alloy, as polished and unetched.

ANTIMONY IMMERSION COATINGS

Although relatively thick antimony electroplates would appear to be of questionable value because of their diffusion characteristics with zinc alloy, depositing a relatively thin coating of antimony and alloying it completely with zinc appeared to have merit, according to the results of evaluating such a coating. By taking advantage of the diffusion characteristics of antimony with zinc, immersion antimony coatings can be converted to adherent alloy coatings.

The immersion coatings were applied by dipping zinc die castings for two minutes in the citrate plating bath maintained at 70F. These die castings were compared with bare die castings and with others that had been treated to apply a protective chromate conversion coating[12] by exposing them outdoors for one year. The antimony diffusion alloy had a metallic appearance after this period of exposure, whereas the untreated die castings were discolored with the dark gray stain typical of weathered zinc. The chromate coatings were

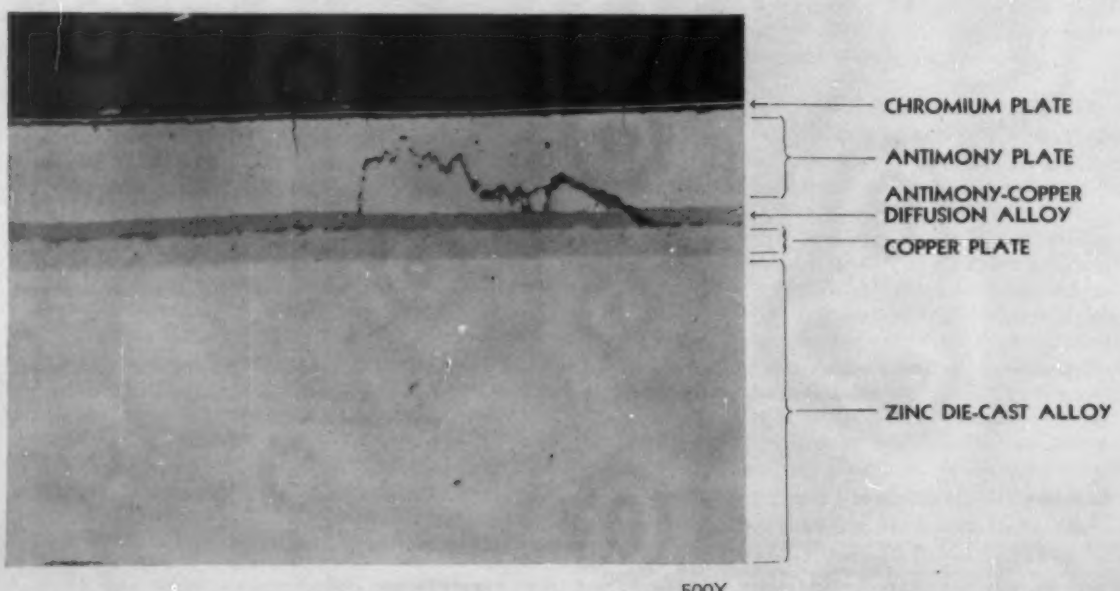

Fig. 2. Copper-plated, antimony plated, buffed and chromium plated zinc die casting showing diffusion alloy of antimony and copper, as polished and unetched.

almost colorless as a result of bleaching. These results suggest that immersion antimony coatings might be used advantageously on zinc plated steel or zinc die castings in place of the nonmetallic conversion coatings.

The alloy that is formed by diffusion at room temperature probably consists of at least 55 per cent antimony, because alloy containing less zinc is equally as active as commercially pure zinc in most environments. The constitution diagram for the antimony-zinc alloy system[14] shows a mixture of zinc with Sb_2Zn_3, for alloys containing 45 per cent or more zinc.

For zinc die castings, consideration must be given to the effect of the antimony on the properties of any die-cast metal reclaimed from scrap. Coated zinc die-cast scrap normally is returned to the melting pots for reuse. Elements that interfere with the die casting operation or are detrimental to the functions of the castings are to be avoided in coatings, unless such elements are eliminated in the slag. It is understood that the allowable limit for antimony plus lead plus tin is 0.010 per cent. Therefore, any use of an antimony coating on zinc die castings must consider the relative importance of the scrap situation.

From thickness measurements of the antimony diffusion alloy layer, determined by measuring at 500 magnification the width of a tapered section, it appears that the antimony deposited by displacement would introduce less than 0.001 per cent of antimony in zinc die-cast scrap. The maximum thickness of the diffusion zone, after storage for one year, was only 6 microinches. The initial thickness of the antimony, before diffusion, probably was less than 4, but more than 3 microinches.

CONCLUSIONS

Conclusions from this research are as follows:

(1) Antimony may be plated adherently and continuously on steel, if the steel is first conditioned by anodic treatment in acid solutions, or is electroplated with iron.

(2) Anodic acid activation of steel prior to plating improved the corrosion resistance of antimony-plated steel, but did not improve the corrosion resistance of zinc-plated steel.

(3) Antimony-plated steel resisted corrosion better than zinc-plated steel in salt spray fog and in air saturated with water vapor, and might be better than zinc-plated steel in other environments.

(4) Protective antimony coatings for zinc deposited by immersion in the citrate plating bath may be more suitable than conversion coatings for certain applications.

(5) Because weak and brittle alloys formed by diffusion at room temperature between antimony and zinc or copper tend to cause blistering or peeling, electroplating antimony on copper-plated die castings or zinc die castings cannot be recommended.

ACKNOWLEDGMENTS

This discussion is taken from research at Battelle Memorial Institute sponsored by The Bradley Mining Company, San Francisco, whose permission to publish is gratefully acknowledged. The authors acknowledge the contributions of W. G. Hespenheide during the initial part of this research.

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CORROSION STUDIES WITH NICKEL-CHROMIUM PLATE

The Influence of the Porosity Pattern and Thickness of the Chromium Plate

by H. BROWN, M. WEINBERG and R. J. CLAUSS*

This report covers new outdoor exposure tests in an industrial atmosphere (Detroit) of nickel-chromium, and copper-nickel-chromium plate, in which special attention was given to the porosity and stress-crack pattern of the bright chromium plate. Not only was the thickness of the chromium plate varied, but the effects of such variables as the temperature of the chromium bath and the ratio of chromic acid to sulfate were also studied. Also, sulfur-free nickel deposits were compared with sulfur-containing nickel deposits, and the effects of variations in the structure of the nickel plate were studied. Photomicrographs of the corrosion pits for all of these systems are shown and the mechanism of the corrosion attack is considered.

The best improvement in the outdoor corrosion resistance of chromium plated fine-grained bright nickel deposits were obtained with the operation of the bright chromium plating bath at 131F (55C), and at ratios of chromic acid anhydride to sulfate of 150 to 1 to 200 to 1, and with the use of at least 0.03 mils of bright chromium plate and more especially with 0.05 to 0.08 mils of bright chromium plate.

With dull nickel, buffed or unbuffed (with its comparatively large-grained columnar structure), the thickness and character of the chromium plate used is not nearly as important as it is with bright very fine-grained nickel. This was one of the most striking results obtained from the study of various chromium plated nickel foils.

Introduction

THE OUTDOOR PERFORMANCE of "chrome" plate (on steel, zinc base die-cast and aluminum) has left much to be desired. In the past it has often been considered that if the porosity of the underlying nickel plate could be eliminated, then greatly improved outdoor corrosion results would be obtained. As a matter of fact, the porosity to moisture of nickel plate that is at least 0.5 mil thick is absolutely negligible as prolonged humidity tests show. It is, however, the porosity of the final thin chromium plate that is a key factor in the corrosion failure of nickel-chromium and copper-nickel-chromium plate.[1]

It is worthwhile to consider the corrosion cell that operates when chromium plated nickel is exposed to a corrosive atmosphere. An industrial atmosphere contains traces of sulfuric acid†, soot, fly-ash and in the industrial cities of the northern part of the U.S.A., salt is used to de-ice the streets in winter. This corrosive atmosphere involving heavy dew condensation in the late autumn, winter and early spring, with the attendant condensation in the dew of traces of acids, soot (and also salt in many cases) sets up the conditions for a galvanic cell. The surface of the chromium plate becomes the cathode and the underlying metal (usually nickel) exposed in the pores or stress-cracks of the bright chromium plate becomes the tiny anodes of the corrosion cell. The large cathodic areas and the very small anodic areas are exactly the conditions that favor rapid corrosion pitting of the underlying metal covered by the thin porous chromium plate. Fig. 1 illustrates this corrosion cell.

From a consideration of this corrosion cell it is obvious, that the thicker the underlying nickel plate or the more resistant the nickel can be made to anodic attack, the better the corrosion protection to the base metal that is plated. Since the corrosion pit bores laterally as well as downward, increasing thickness of nickel plate past about 0.5 mil gives geometrically improved corrosion resistance that is, a 1.5 mil thick nickel plate gives much more than twice the protection that a 0.75 mil thick plate would give, assuming the same chromium plate was applied. In general the least objectionable corrosion pit is the type that tends to widen at the top at a faster rate (at least about double or more) than the rate of penetration downwards toward the basis metal. Also the

* The Udylite Research Corp., Detroit 11, Michigan.

† Besides the sulfuric acid and sulfurous acid from the burning of coal, the exhaust gases of internal combustion engines contribute other acids to the atmosphere.

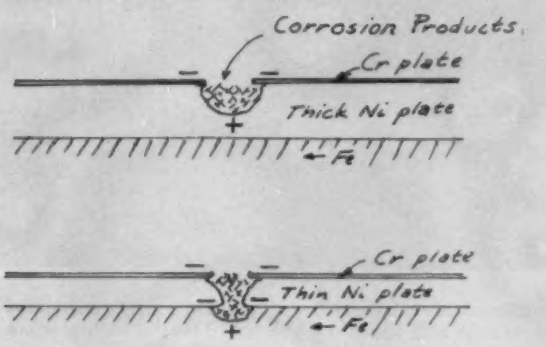

Fig. 1 Illustration of the galvanic corrosion cell which operates when an acidic or saline solution covers a chromium plate that has porosity. The corrosion starts at a pore or stress-crack in the thin bright chromium deposit, with the passive chromium surface around the pore as cathode and the metal exposed in the tiny pore as anode. As corrosion proceeds the pore is enlarged. With thicker nickel plate underlying the thin chromium plate geometrically increased protection is afforded to the basis metal.

distribution density of the pores in the chromium plate is a very important factor. A very great many small pores very close together may be less harmful than a medium dispersion of pores in the chromium plate, in the sense that the cathodic areas and the anodic areas (pores) would be more nearly equal, and thus the rate of corrosion pitting penetration would be less. Of course, the absence of pores in the chromium plate would be the optimum condition for best corrosion protection in a given corrosive environment. Furthermore, certain stress-crack patterns in the chromium plate are often really less harmful than pores because the anodic area is not concentrated to a point attack as in a pore. Of course, there is always the possibility of eliminating the large cathodic area (the conducting area) of the chromium plate, by covering it with an insulating film for example, oil, wax, or a good thin non-yellowing clear lacquer, etc., which obviously greatly aids the corrosion protection. In this latter connection it is worthwhile to emphasize that paints are often more porous than chromium plate, but because they are electrical insulators, the corrosion cells that occur in any pores in the paint consist of tiny cathodes and anodes and pitting corrosion is not particularly favored.

In this discussion, however, the main results that were obtained involve the corrosion data obtained with variations in the chromium plate and the underlying nickel plate. The data were obtained from the outdoor exposure in an industrial atmosphere of chromium plated nickel foils, of nickel-chromium plated steel and copper-nickel-chromium plated steel and zinc die-cast. Also the results obtained with such accelerated tests as acetic acid salt spray, Corrodkote (a kaolin coating containing ferric chloride, ammonium chloride and cupric chloride), and the use of nitric acid vapor, etc., will be given for purposes of correlation with the outdoor exposure results in an industrial atmosphere.

The Porosity and Stress-Crack Pattern of Bright Chromium Plate

In order to better study the well-known porosity and stress-crack pattern of the bright chromium plate in the laboratory, nitric acid vapor[2] was used to attack the underlying metal exposed in pores and cracks in the chromium plate. Since concentrated nitric acid will not appreciably attack chromium plate, this method of studying the porosity and stress-crack pattern of chromium plated nickel appears to be very good and differences in the porosity and stress-crack pattern of the chromium plate are readily and clearly shown by this method. Chromium plate of various thicknesses (0.005 to 0.1 mil), plated at different bath temperatures, and different ratios of chromic acid to sulfate were studied in the following manner. Buffed brass panels were plated with 0.2 mil bright nickel and then chromium plated under various conditions, and then the "chrome" plated brass panel was used as a cover over a wide mouth Erlenmeyer flask partially filled with concentrated nitric acid. The nitric acid is preferably kept warm (50C) for more rapid attack with the vapor of the nitric acid. At the end of 50 minutes or less a very clear pore or crack pattern in the chromium plate can be obtained. With thin chromium plate, 0.01 mil and less, usually only pore patterns are obtained, and with thicknesses of chromium over about 0.02 mil, stress-crack patterns are usually obtained. Typical pore and stress-crack patterns are shown in Fig. 2. As is well-known by other methods of study,[3] the pore pattern of this chromium plate and the stress-crack pattern of thicker chromium plate varies markedly with the temperature of the chromium bath. It also varies with the ratio of chromic acid to sulfate and with other factors such as the nature and structure of the metal on which the chromium plate is deposited, its stress, etc. The results of an extensive study of this type showed that the *bright* chromium plate obtained at chromium bath temperatures of around 131 F(55C) had minimum porosity and stress-cracks for chromium plate of 0.02 to 0.08 mil thickness. These conditions were exactly the same con-

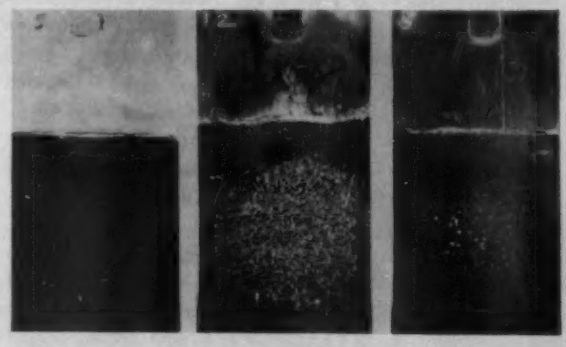

Fig. 2 The well-known porosity and stress-crack patterns in thin (0.01–0.03 mils) bright chromium deposits as shown by the corrosion with nitric acid vapor of the metal (nickel and brass) underlying the thin bright chromium deposit. The porosity pattern is obtained with the thinner (0.01 mils and less) chromium plate, and the stress-crack patterns with the thicker (0.02–0.03 mils) chromium plate if the temperature of the chromium bath is below about 120F. At about 131F (55C) and especially with ratios of chromic acid anhydride to sulfate of about 130 to 1 to about 200 to 1 no porosity or stress-crack pattern is shown after 4 hours' exposure to warm (50C) nitric acid vapor. (Panel on the left).

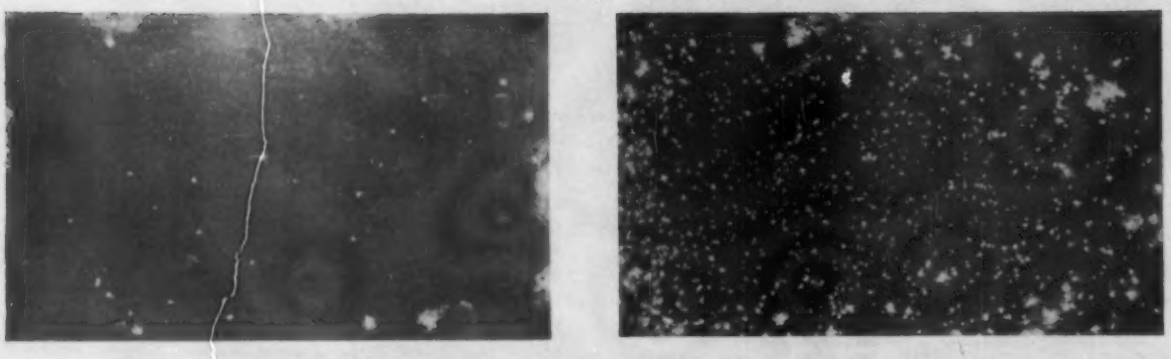

Fig. 3 Typical results of one year outdoor exposure in an industrial atmosphere (industrial area of Detroit) of 6 x 4 in. steel panels plated with 1 mil bright nickel and different chromium plates. The 0.03 mil bright chromium plate from a 130F bath (a, left) gave far superior results compared to 0.01 mil chromium from 110F bath (b, right).

ditions prescribed long ago (1928) by Baker and Rente[3] for obtaining "nearly perfect" bright chromium plate. These conditions are also optimum for obtaining the best throwing power as was shown in 1930 by Blum and Farber.[4] It was found not only that a temperature of around 131F (55C) gave minimum porosity and minimum stress-cracking in the thicker (0.02 to 0.08 mils) bright chromium plate, but that the higher ratios of chromic acid to sulfate such as 150 to 1 and 200 to 1 in the 250 g/l (32 oz/gal) chromic acid bath also helped to give a minimum porosity with a given thickness of chromium plate. The main drawback of the higher bath temperature is not the loss of brightness of the chromium plate, but the necessity of using about twice the current density (about 35 amp/sq dm or 280–325 amp/sq ft) compared to operation at the usual bath temperatures of about 100 to 115F. In automatic machines or in hoist-line operations, the use of low voltage (2 to 3 v) on the entry of the work into the 130F chromium bath before the full plating voltage (or rather current density) is applied, makes possible better chromium coverage, and less tendency to bluish chromium plate. This is good practice anyway for all chromium plating. With bright chromium plate of about 0.02 to 0.03 mils thick obtained from the 130F chromium bath operated at a ratio of about 130 to 1 to 200 to 1 of chromic acid to sulfate, the nitric acid vapor shows no attack pattern in the center area of the 6 by 4 in. panels in four hours (no pore or crack pattern is discernible). This does not mean that absolutely no crack patterns will develop with time, or by heating. It does show, however, that minimum porosity and minimum stress-cracking is obtained at this temperature and ratios of chromic acid to sulfate with bright chromium plate of 0.02–0.03 mils thicknesses and better yet up to 0.08 mils thickness.* These results were completely borne out by outdoor exposure results obtained in an industrial atmosphere (Detroit), in an area heavily contaminated with the smoke from trains.

* Since the higher temperatures (130F) and the high ratios of chromic acid to sulfate (200 to 1) favor the electrodeposition of basic chromium chromate films, the improved corrosion resistance and protection may be due in part to this corrosion inhibitor itself as well as its possible involvement in the greatly decreased porosity and stress obtained at 130F and 200 to 1 ratios. The chromium plating baths using the higher ratios of chromic acid to sulfate of 200 to 1 are sometimes more difficult to operate without "rainbow" trouble compared to lower ratios of 150 to 1 or 125 to 1. These latter ratios also give improved results compared to 75 to 1 and 100 to 1 ratios.

Outdoor Exposure Results in an Industrial Atmosphere

In a series of 6 by 4 in. steel panels all plated with 1 mil of bright nickel, and chromium plated with various thicknesses of bright chromium plate obtained at various chromium bath temperatures and ratios of chromic acid to sulfate, the results at the end of one year of exposure (Fig. 3), show the far better corrosion protection obtained with the bright chromium plate from the 130F bath (250 g/l chromic acid) and with a ratio of 125 to 1 to 150 to 1. Also the results with accelerated tests such as the acetic acid salt-spray and Corrodkote were better. Salt-spray results and acetic acid salt-spray results were excellent. For the best outdoor results as well as acetic acid salt-spray and Corrodkote results the chromium plate should be at least 0.03 mils thick.

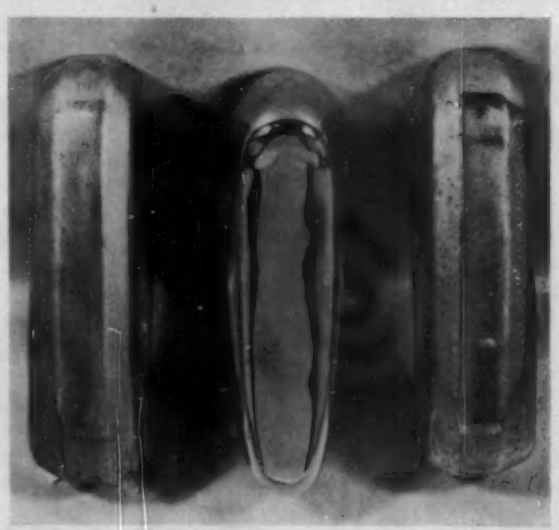

Fig. 4 Bumper-guards after 3 years' exposure in an industrial atmosphere (untouched). (Left) 1.25 mils bright nickel with 0.01 mils chromium from 110F bath. (Center) 1.25 mils bright nickel with 0.05 to 0.08 chromium from 130F bath. (Right) 1.25 mils buffed sulfur-free semi-bright nickel with 0.01 mils chromium from 110F bath.

The superior corrosion protection resulting with the thicker bright chromium plate on bright nickel is obvious.

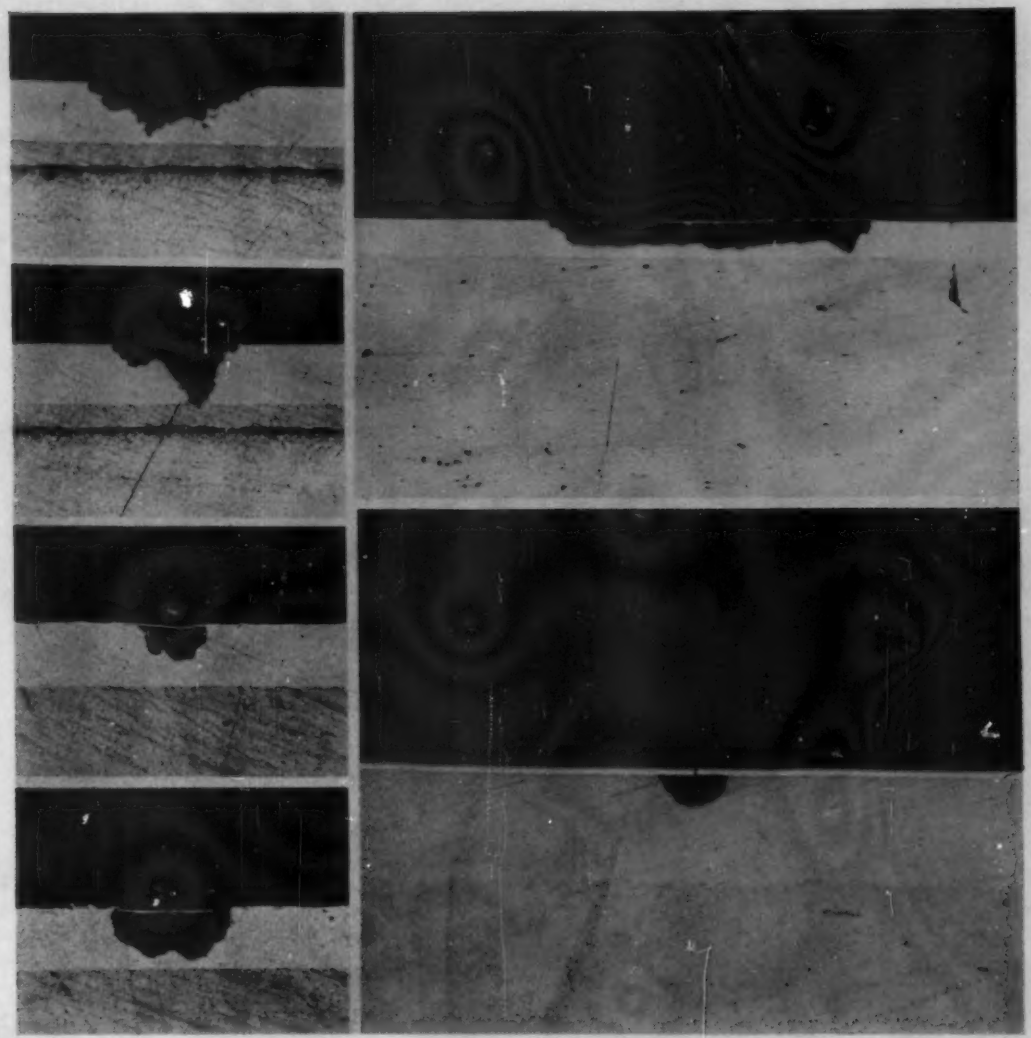

Fig. 5 Corrosion pits (750X) at the end of 3 years' exposure in an industrial atmosphere. In (a, top left) and (b, next top left) zinc die-cast plated with 0.4 mils copper and 0.9 mils nickel and 0.03 mils chromium. In (c, center left) and (d, bottom left) steel plated with 1.5 mils copper and 0.8 mils bright nickel and 0.05 mils chromium. In (e, top right) steel plated with 0.85 mils bright nickel and 0.05 mils chromium, and in (f, bottom right) steel plated with 0.9 mils bright nickel and 0.07 mils chromium from 130F bath. Original magnification of (e) is 250X, and (f) is 750X. The thicker chromium plate is not as readily flaked away by the corrosion products and the corrosion pits then tend to widen faster in the nickel than the rate of penetration downward which is very desirable.

In a comparison study with bright nickel containing sulfur (as sulfide) versus both a semi-bright nickel containing sulfur but having a partial columnar structure, and a sulfur-free semi-bright nickel, it was found that in all cases with the usual thin (0.01–0.02 mils) chromium plate (110F chromium bath temperature), the sulfur-free columnar structure Watts nickel plate and the semi-bright sulfur-free nickel gave the best corrosion protection at the end of one year exposure. This difference is shown in a quite pronounced but perhaps quite exaggerated manner in the Corrodkote test. The reason the difference may be quite exaggerated is that when very thin chromium plate is used, e.g. only a 5-second flash, then the Corrodkote results are always very good, and this again shows the very important influence of the porosity pattern of the chromium plate. With the very thin flash of chromium the porosity pattern is more dense as it is on dull nickel or semi-bright nickel, thus making possible smaller cathode areas around each pore, and hence much smaller but more densely distributed corrosion pits results. In any case, by the end of three years, the differences are negligible between the sulfur-free semi-bright nickel and the bright nickel that were both chromium plated in the usual manner, 0.01 mils chromium from 105–115F (Fig. 4). Whereas 1 to 1.5 mils of bright nickel plated with chromium from the 130F bath to a thickness of about 0.08 mils is practically perfect (Fig. 4) at the end of three years. There are no corrosion pits though a stress-crack pattern is visible in portions of the chromium plate at a distance of about two feet. However, this crack

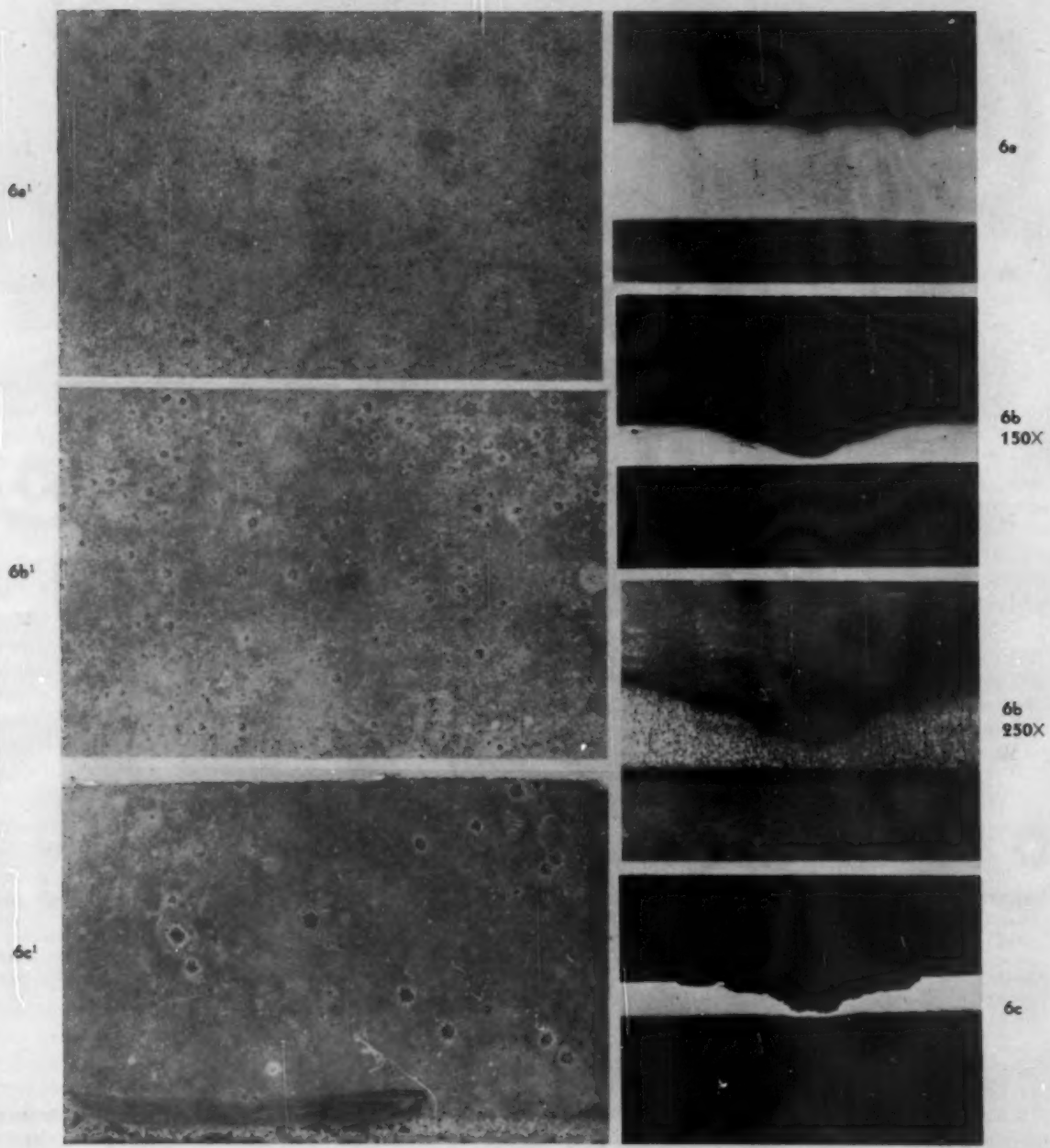

Fig. 6 Corrosion pits in chromium plated nickel foils after 3 years' exposure in an industrial atmosphere.

(a, top right) Buffed Watts dull nickel with 0.01 mil chromium plate. Very small pits (250X) that are very close together. Surface losing its luster because of the closeness of the pits. Same corrosion pit pattern was obtained with unbuffed dull Watts nickel similarly chromium plated. In (a¹, top left) the surface appearance of above foil is shown at 9X magnification.

(b, center right) Bright side of a dull Watts nickel foil with 0.01 mils chromium plate. Note the much larger width and depth of the corrosion pits (150X) compared to (a). The same corrosion pit in the foil after etching to show columnar structure of the dull Watts nickel foil. The results are very similar to identically chromium plated bright nickel foil shown in (c). In (b¹, center left) the surface appearance of foil (b, center right) is shown (9X). Note how much larger the pits are than in (a¹) and also how much farther apart.

(c, bottom right) Bright nickel foil with 0.01 mils chromium plate. Note the striking similarity with (b), though the pits (150X) are a little bit wider, a little bit deeper, and a little more spread apart. In (c¹, bottom left) the surface appearance of foil (c) is shown (9X); actually foils (b) and (c) look more closely alike than these photographs show.

pattern is not dull or unsightly looking. Thus, the bright nickel plated with chromium from the 130 F bath to a thickness of 0.03 mils to 0.08 mils was superior to sulfur-free semi-bright nickel of the same thickness, but plated with the usual 0.01 mils of bright chromium from the usual 100 to 115F chromium bath.

To further show the striking contrast in corrosion results obtained with variations in the bright chromium plate, a series of photomicrographs of corrosion pits in nickel-chromium and copper-nickel-chromium plates on steel and zinc die-cast are shown (Fig. 5). It will be noted that thicker bright chromium plate of minimum stress and porosity does not tend to flake away at the site of a corrosion pit and thereby tends to promote lateral corrosion of the nickel instead of rapid penetration toward the basis metal. This is a very important attribute when the metal that is undergoing lateral corrosion is nickel, first because of the very slow corrosion of nickel, hence no blisters or unsightly corrosion products. Also the results obtained with chromium plated nickel foils including chromium plated bright nickel foils, chromium plated pure Watts nickel foils, buffed and unbuffed, chromium plated sulfur-free (but containing small percentages of carbon) semi-bright nickel foils and the chromium plated bright side of a dull nickel foil are very instructive. Most of this work will be reported in a subsequent paper. The bright side of the dull nickel foil was obtained by passivating a thick (10–20 mils) bright nickel foil and then plating thick dull nickel from a Watts bath on the bright nickel, and then stripping the dull nickel deposit. The stripped dull nickel foil had a brilliant surface, the exact duplicate of the bright nickel surface from which it was stripped. This bright side of the dull nickel foil when chromium plated gave almost exactly the same corrosion results (practically the same number and distribution pits of very nearly the same width and depth as the similarly chromium plated bright nickel foil, Fig. 6). By varying the chromium plate thickness and the temperature of the chromium bath different corrosion pit patterns and different depths of pit penetration were obtained. With the usual chromium plate, the number of corrosion pits obtained in dull nickel was very large, about 80 to 120 pits per linear centimeter at the end of three years' exposure in an industrial atmosphere, however, the rate of penetration was small. Whereas with bright nickel (and the bright side of dull Watts nickel foil) plated with the same chromium plate, about 8 to 25 corrosion pits were obtained per linear centimeter, but their width and depth of penetration was much greater than with the dull nickel (buffed or unbuffed), as already described. However, by using a flash of dull nickel or a semi-bright nickel or a low *p*H nickel strike (or in general a flash of nickel plate having the similar columnar structure or partial columnar structure as the dull nickel in a thickness that does not unduly dull the bright nickel), and then using the regular or usual chromium plate of 0.01 mils thickness excellent Corrodkote results were obtained. The outdoor exposure tests with the bright chromium covered flash plates of columnar structure or partially columnar structure nickel on top of the very fine-grained bright nickel have not yet been carried out for a sufficient duration for complete evaluation.

Thus, the results show that the porosity pattern of the thin chromium plate was different on dull nickel or columnar-type nickel than on bright very fine-grained nickel, and this is a major factor in the difference between the usual bright chromium plated dull nickel and the very fine-grained bright nickel on outdoor exposure in a corrosive atmosphere.

This difference in porosity pattern of the thin chromium plate on dull nickel versus bright nickel was mentioned in the printed discussion to the paper cited in reference 1, and it was also pointed out that there is a difference in porosity pattern of thin chromium plate on electrolytic iron (columnar structure) plate and on high grade cold rolled low carbon steel.

It appears that hydrogen embrittlement of the bright nickel by the gassing during chromium plating is not an important factor in corrosion of undistorted plate. In experiments conducted by D. Millage in this laboratory, cathodic gassing of 1 mil bright nickel plated steel in an alkaline bath at 200 amp/sq ft for five minutes (this gives hydrogen embrittlement quite equivalent to five minutes of chromium plating), did not give a different Corrodkote result compared to a control panel of the same bright nickel without any cathodic gassing. Both panels without chromium plate showed no rust spots at the end of over three months in the humidity cabinet. The Corrodkote was left on the panels during this time. Also, before applying the Corrodkote, the cathodically gassed nickel plate was given a 30 second dip in 20 per cent hydrochloric acid to be sure no alkaline film was left on the nickel by the alkaline cathodic gassing.

In a previous report[1] we had mentioned that when bright nickel plate covered with 0.04 to 0.08 mils of chromium from the usual 110F chromium plating bath was exposed for five years in an industrial atmosphere, the bright chromium plate developed a frosty appearance characteristic of highly stressed chromium. This frosty appearance did not develop with the 0.04 to 0.08 mil chromium plate on bright nickel from the 130F bath, as can be seen in Fig. 4. Actually 0.03 mils of bright chromium from the 130F bath had much less stress cracks than 0.01 to 0.02 mils of chromium from the 110F bath applied to the same bright nickel plate. This is besides the fact that it also gave vastly improved corrosion protection (see Fig. 3).

There is no question that the use of the 130F chromium bath, preferably at ratios of about 125 to 1 or 150 to 1 of chromic acid anhydride to sulfate, or any other type bright chromium plating bath[6] that has minimum porosity and stress, and plating about 0.03 to 0.08 mils thickness of chromium plate, will result in great improvement in outdoor corrosion resistance of "chrome" plate (Fig. 4). Of course, the nickel plate is of primary importance, however the type of chromium plate on bright nickel must not be neglected. That is, the thickness of chromium on bright nickel for excellent outdoor results should be at least 0.03 mils, and obtained preferably from a high ratio (125 to 1 to about 150 to 1) of chromic acid to sulfate bath, and most preferably from a bath that is both high ratio and warm 120F) bath. The high ratio and the higher temperature both yield bright chromium of minimum porosity and stress-cracking in the thicknesses of 0.03 to 0.08 mils chromium.

Acknowledgment

The authors wish to express their thanks to Wilbur Hague for his photomicrographic work, and to D. Millage for valu-

Fig. 7 A corrosion pit (1000X) in a bright nickel foil plated with 0.03 mils chromium and exposed 3 years in an industrial atmosphere. Note the smallness of the pit at this magnification, also these pits were not close together. Compare with Figs 6 (b) and 6 (c) where thinner chromium plate (0.01 mils) was used on the bright side of dull nickel foil and on the bright nickel foil.

able suggestions, and to E. Hoover and R. Klein for advice and help. We also want to thank Dr. R. B. Saltonstall for his very helpful suggestions.

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PRODUCTION OF PRINTED CIRCUITS:

The Photosensitive Resist Method

by WERTER P. VAN DEUSEN*

The principal methods of manufacturing printed circuits include photomechanical printing, mechanical stamping, and photoengraving techniques. The photoengraving method is the one best suited to making either etched or plated circuits to fine or coarse tolerances in large or small quantities, although it is more complex than the others and must be performed on each circuit panel.

Use of a photoresist is advantageous in all three circuit fabrication methods. A waterproof plastic photoresist coating, though more costly than bichromated colloid coatings, offers improved reliability in a wide variety of etching and plating processes.

Factors that ensure reliability in circuit manufacture include proper cleaning of the metal support, suitable chemical surface treatment to promote adhesion of the resist, control of resist coating conditions to maintain and enhance adhesion, control of optimum exposure, and a preplating cleaning cycle which does not impair the capabilities of the resist image.

INTRODUCTION

PRINTED CIRCUITS ARE CONDUCTIVE PATTERNS of wires and components formed on an insulating support. Although many printed-circuit fabrication methods are being tried, the principal ones fall into three classes: photomechanical printing methods, mechanical stamping methods, and photoengraving techniques. A fourth type, the photoconductive printing method, has been announced recently. Its technology, as it develops, will be worth watching. While each of these methods obviously includes several variations, all of them use—or could use to advantage—a photosensitive resist (or photoresist) at some stage during fabrication.

For example, photomechanical techniques, represented by Fig. 1, include the screen printing process and the lithographic and letterpress printing methods. A light-sensitive stencil material is used to prepare the circuit stencil photographically from a positive transparency of the original artwork, and a photoresist is used to photograph the circuit image on a master lithographic or letterpress printing plate. With mechanical stamping processes (Fig. 2), the photoresist is effective for transferring the circuit image photographically to the face of a stamping or embossing die by chemical etching or plating techniques.

By the photoengraving method (Fig. 3), a photoresist coating must be applied to each panel on which circuits are to be formed. After exposure to the circuit image, the unexposed coating on each panel is washed away, to leave a resist image in circuit areas or noncircuit areas, depending on whether etching or plating techniques will be used.

Photographic techniques are also useful in producing the drilling and punching templates for circuit panels. By the photoengraving method, hole centers in the template can be indexed photographically from the artwork for the circuit itself—to obtain maximum register with circuit terminations.

Of the three circuit fabrication methods compared in Table I, the photoengraving technique has the greatest versatility and is the one most capable of reproducing extremely fine circuitry to close tolerances. Revisions in circuitry can be made quickly and easily. It is suitable for preparing prototypes, for making short production runs, and for long runs on patterns beyond the resolution, registration, and definition capabilities of the other processes. Where comprehensive circuit-making facilities by a single process are required, it is

TABLE I

Characteristics of P-C Methods

Process Characteristics	Photoengraving Method	Mechanical Stamping	Photomechanical Printing
Flexibility	Maximum	Limited	Limited
Precision	Maximum	Limited	Limited
Size of Production	Samples, medium and long runs	Long runs	Medium and long runs
P-C Types	All etched or plated types	Stamped, embossed, compressed powder	Fused, etched
Complexity of production	High	Average	Above average
P-C Unit production cost	High to medium	Medium to low	Medium
Automation possibilities	Excellent	Excellent	Excellent

* Research Laboratories, Eastman Kodak Company, Rochester, New York.

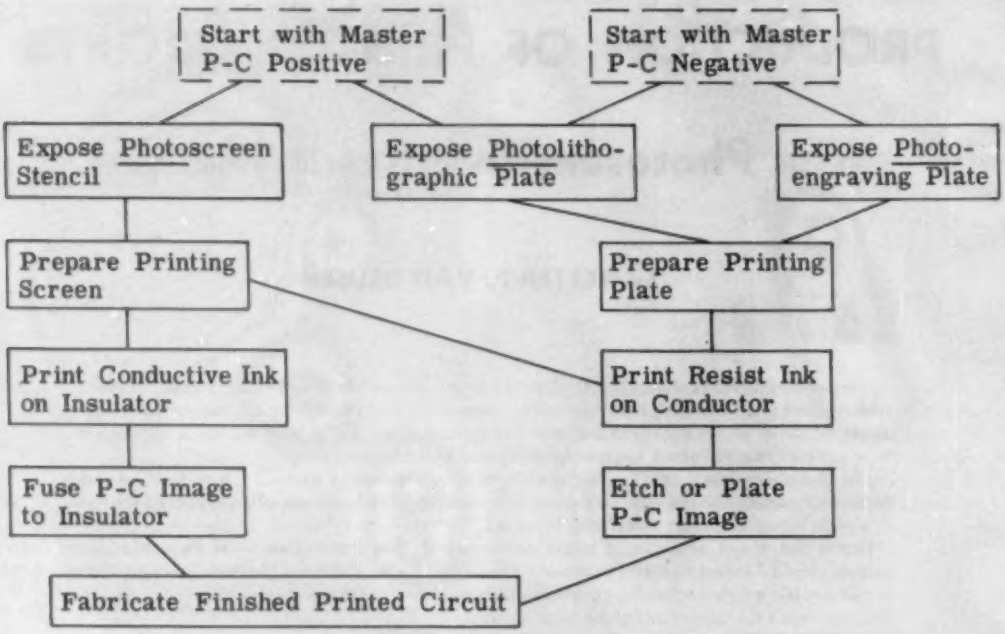
Start with Master P-C Positive
Start with Master P-C Negative
Expose Photoscreen Stencil
Expose Photolithographic Plate
Expose Photoengraving Plate
Prepare Printing Screen
Prepare Printing Plate
Print Conductive Ink on Insulator
Print Resist Ink on Conductor
Fuse P-C Image to Insulator
Etch or Plate P-C Image
Fabricate Finished Printed Circuit

Fig. 1—Photomechanical P-C Fabrication Processes.

the only method now capable of making either small or large quantities of circuits, identical or varied, to fine or coarse tolerances, with consistent reliability.

WATER-SENSITIVE RESISTS

The photosensitive resist is largely responsible for the many pictures that are taken for granted in printed publications today. For years, shellac, fish glue, gelatin, and other natural organic colloids have been used by the printing industry as resists for etching printing plates. They are made light-sensitive by adding chromium salts which insolubilize the colloid coating when exposed to ultraviolet radiation and blue light.

During the past fifty years, the techniques of using bichromated colloid resists have remained essentially the same despite serious shortcomings. Although excellent printing has been done, and obviously is still being done with them, they are unpredictable in their behavior. They have uncertain response to light and the coatings do not keep well.

The photoengraver has learned to live with these difficulties where each printing plate is unique. However, they present problems in printed-circuit production where the reliability factor rates high and craftsmanship is a luxury which cannot be afforded. This situation exists in spite of much research and development work spent to overcome these difficulties.

The fact remains that bichromated colloids form water-sensitive coatings. Their sensitivity and stability to light are markedly affected by ambient temperature and humidity. Their resistance to aqueous etching and plating baths used in making printed circuits is marginal by their very susceptibility to moisture.

Commercial formulations of bichromated shellac or "cold top" are the most useful of this class of photoresist for printed-circuit work. Their greatest assets are that the material cost is low and they can be processed in water and in alcohol. Provided the production variables are very carefully controlled, etched copper circuits can be produced with reasonable reliability, by using a bichromated shellac resist.

ORGANIC SOLUBLE RESISTS

A recent development in the photosensitive resist field is a light-sensitive, waterproof, plastic coating designed to overcome the problems associated with bichromated colloids. It has application in all branches of printing platemaking, as well as in nameplate, die-tool, and printed-circuit fabrication. This product* is more light-sensitive than the bichromates, and coatings of it on metal remain stable for a year or more. Thus, quantities of circuit panels can be presensitized and stored for use as needed.

The resist can be dip-coated, flow-coated, whirler-coated or spray-coated, and handles like a conventional solvent-based lacquer. Exposed images can be developed using trichloroethylene in a commercial vapor degreaser, a device which is well adapted to automatic production techniques. The main drawbacks of the resist are the necessity of processing it with organic solvents and its higher material cost when compared with bichromated shellac.

On the other hand, the resist performs equally well on a wide variety of metals with etches containing nitric acid, hydrochloric acid, aqua regia, ferric chloride, chromic acid, concentrated caustic and many other reagents. It also resists electroplating baths for solder, copper, tin, nickel, rhodium, chromium, zinc, silver and gold.

A unique property of the resist can be used in preparing etched copper circuits. After a circuit has been etched, the resist does not have to be removed. Instead, it remains to protect the circuit from contamination during subsequent stages of blanking, punching, storing, assembling components and applying the flux. By judicious choice of a flux, and solder-pot operation at 500–550F (260–288C), a three- to

* Kodak Photo Resist or KPR.

five-second solder dip removes the resist, fluxes the copper, and solders the circuit reliably in a single operation.

PHOTORESIST PROCESSING STEPS

The remainder of this paper will describe typical processing steps used with a photoresist and some of the considerations promoting increased reliability.

First in sequence and importance is the preparation of the coating surface—the copper-foil laminate in this case. Fundamentally, any metal surface that is to be coated with an organic material must first be cleaned thoroughly of any oily or greasy residue to obtain the best possible adhesion. Moreover, this adhesion usually can be improved by suitable chemical surface treatment following the cleaning step. Finally, optimum washing and drying conditions following the chemical treatment can assist in promoting still greater adhesion. Any compromise in the care used in these three operations will inevitably impair the quality of the final result and the reliability of the over-all process.

Cleaning the Coating Surface

Three methods of cleaning the coating surface are: by physical abrasion, by laundering methods, and by solvent degreasing operations.

Abrasive cleaning removes organic residue by physically undermining it. Methods include simple scouring or scrubbing with an abrasive cleaner, sand-blasting and vapor-blasting.

Laundering operations include all treatments with detergent, soap or alkali. When using a photoresist, however, laundering operations should be limited to soaking in hot alkaline solutions, with or without the aid of anodic or cathodic electro-cleaning action. Soaps or detergents should be avoided, as they tend to leave a surface-active residue on the coating surface despite thorough rinsing. These residues impair the adhesion of organic coatings.

Degreasing methods remove oil and greasy residue by washing the surface with an organic solvent for these materials. Well-known methods include soaking in an emulsion of organic solvents and water, and treating the surface with trichloroethylene in a vapor-spray degreasing machine.

An indication that a metal surface has been properly cleaned is its ability to maintain an unbroken film of water over the entire cleaned surface without the aid of wetting agents. Once cleaned, subsequent processing steps should proceed immediately since the clean surface is extremely susceptible to recontamination in our normally oily atmosphere.

Where circuits are to be formed by electroplating solder or a metal on the copper laminate, buffing the copper surface initially on a cloth wheel is particularly beneficial. It provides a smoother coating surface that results in greater uniformity in resist thickness, electroplating current density, and plating thickness. "Pinholing" and "plate-through" difficulties are minimized.

Chemical Pretreatment for Improved Adhesion

It is an old "rule of thumb" that organic coatings adhere best to a clean metal surface which has been acidified prior to coating. Other chemical surface treatments for the more difficult metals include: chemical conversion of the surface to an oxidized or reduced state, renewing the surface by chemical etching and coating the surface with a metal film formed either by chemical reduction, galvanic action or electroplating.

With circuit copper, however, the use of a 5 to 10 per cent hydrochloric acid dip gives the best adhesion, although it represents an extra production step. Some circuit makers have successfully avoided this step by resorting to still further buffing and abrasive cleaning in the previous step. Nevertheless, the hydrochloric acid dip is still beneficial, if only for its prefluxing action on the copper surface. Reliability will be improved at the final dip-soldering stage.

To complete a chemical surface treatment, the surface should be suitably washed and dried. In some processes, greater adhesion is obtained by drying the chemical treatment solution directly on the metal surface; by using distilled water instead of tap water; or by using hot water instead of cold water. With circuit copper, however, merely washing the surface thoroughly with water is adequate.

The rate at which moisture is dried from the metal surface is also important and depends on the chemical treatment used. Optimum adhesion may require that moisture be allowed to evaporate under ambient conditions, or be removed by squeegeeing, or by rinsing with a water-miscible solvent, or by drying in forced hot air. Extreme cases may require a high-temperature bake as the final drying operation. For

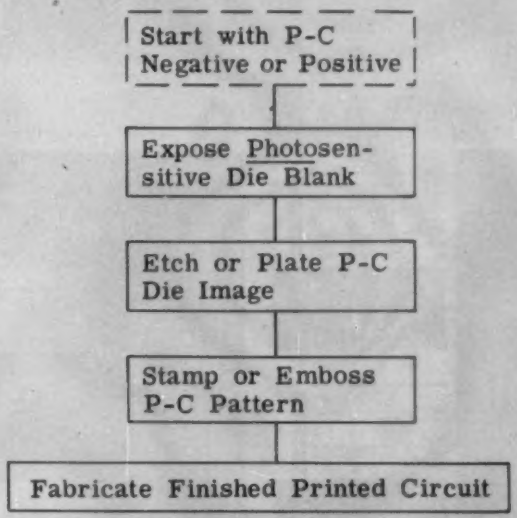
Start with P-C
Negative or Positive
Expose Photosensitive Die Blank
Etch or Plate P-C Die Image
Stamp or Emboss P-C Pattern
Fabricate Finished Printed Circuit

Fig. 2—Mechanical P-C Stamping Process.

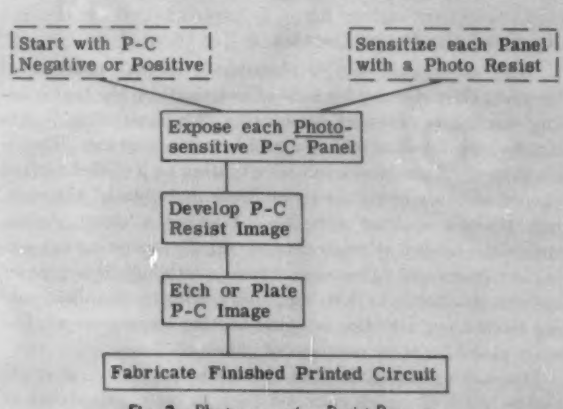

Fig. 3—Photoengraving Resist Process.

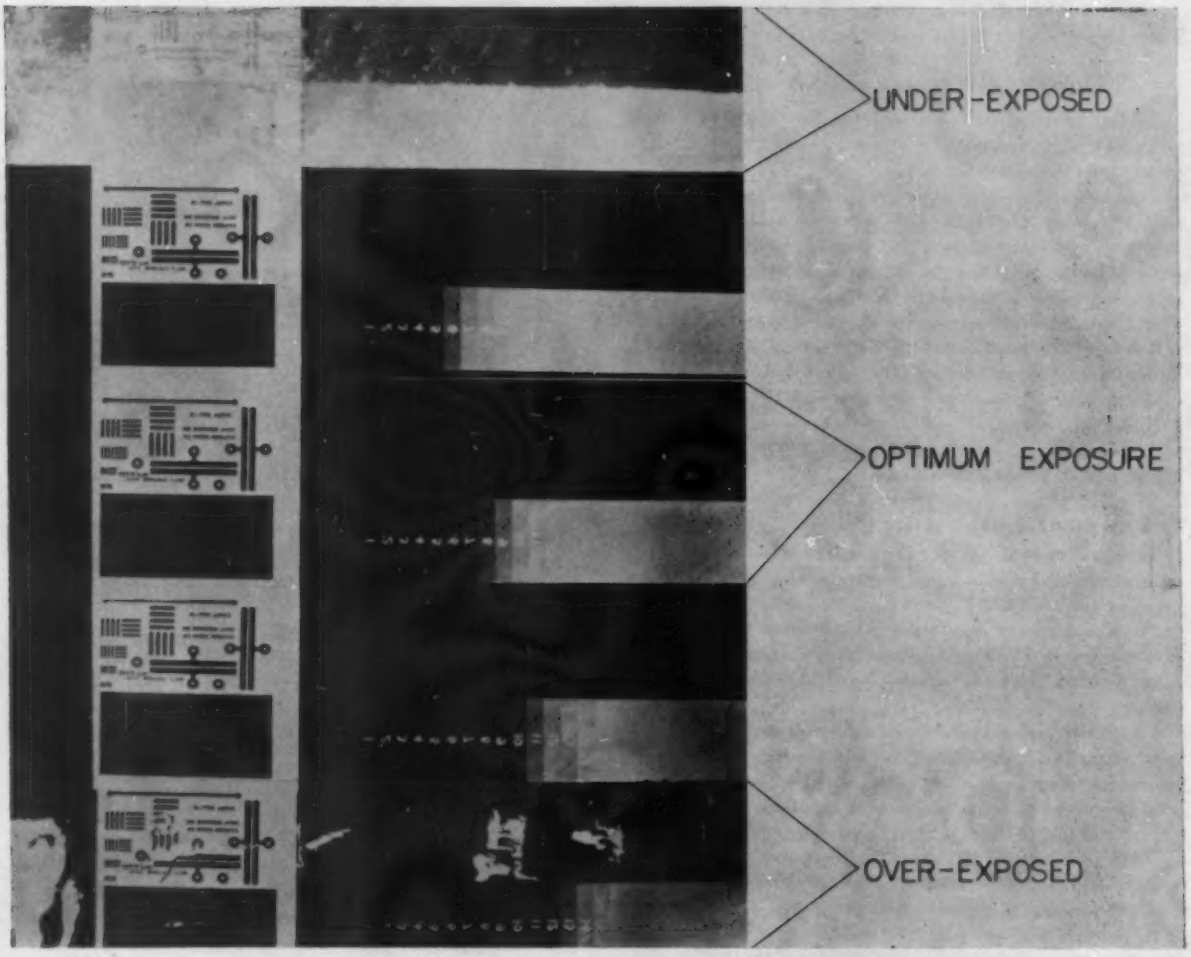

Fig. 4—Exposure Series Test Panel.

circuit copper, drying in forced hot air at 125F (52C) gives optimum adhesion.

The panel is now ready to be coated with a light-sensitive resist. This should be done just as soon as possible to avoid recontamination by the oily, corrosive air.

Applying the Resist Coating

With an organic soluble photoresist, as with commercial lacquers that also dry by solvent evaporation, the best coating quality is obtained by coating the panel after it has reached equilibrium with the ambient temperature. This is because drying solvents out of a coating on a chilled surface causes moisture in the air to condense and "blush" the coating, thereby spoiling adhesion. Coating a warm surface causes the solvent to evaporate too rapidly, resulting in coating striations and other unevenness. Although this type of resist is adaptable to flow, dip, spray, whirler, or roller coating techniques, the dip- or spray-coating techniques are the most useful for large numbers of panels.

Dip-coating simply involves complete immersion of single panels, pairs of panels clamped back to back, or batches of them held in suitable racks, followed by withdrawal and draining them in a vertical position under ambient conditions until dry. Although this procedure obviously results in wedged coatings which will be thinner at the top edge of the panels than at the bottom, it does not present any problem for some types of circuits. Where it cannot be tolerated, a second dip with the panels reversed eliminates most of the wedging. The advantages of dip-coating are its simplicity, minimum requirements for equipment and skill, and the possibility of salvaging, refiltering, and returning the drainings to the coating-solution container.

Spray-coating, on the other hand, requires either a skilled manual operator or automatic spray equipment to obtain coatings of uniform thickness. In addition, a spray booth with adequate exhaust is necessary for safe practice, and a well-filtered pressure-controlled, compressed air supply is needed to operate the spray gun. There is no opportunity to recover coating solution lost in the over-spray, and this loss can easily amount to as much as 50 per cent. Some initial tests will be necessary to determine the optimum amount of thinner to use with the resist to suit the spray operator, the type of gun, and the coating thickness required. In spite of these characteristics, spray-coating offers the greatest versatility for coating a variety of shapes and contours quickly and uniformly.

For the same reason that the panel was allowed to cool to ambient temperature before it was coated, greater reliability is obtained by drying a solvent-based coating at ambient temperature until it "sets." Then, various forced drying techniques may be used to speed the evaporation of residual solvent until the coating is completely dry.

Forced drying methods include drying under radiant infrared lamps or electric strip heaters, and drying in a current of circulated hot air. The latter method is fast and easily controlled. Temperature control with radiant heating is more difficult to measure and maintain, and drying in stagnant hot air is slow and more uncertain.

EXPOSING THE RESIST

The sensitized panel is now ready for exposure to the master circuit image. To obtain the sharpest image, the photoresist must be in intimate contact with the circuit negative or positive. The most reliable way of accomplishing this is to use a vacuum exposing-frame. Normally, exposure is made to a white-flame carbon arc lamp, although alternative ultraviolet sources include mercury-vapor discharge lamps and "black-light" fluorescent tubes. Several of the latter may be arranged side by side to provide a uniform, cool, broad source of illumination which can be used within two or three inches of the exposing frame. Several commercially available vacuum frames use this cold-grid light source.

Regardless of the type of light source, or its intensity or its distance from the light-sensitive coating, there will be, in every case, an exposure range over which the coating receives satisfactory exposure for the specific processing conditions encountered. Thus, exposure is a variable which depends on the many other variables present in the process. For maximum reliability, as many of these as possible obviously must be controlled. Exposure of the resist is a controllable variable but the exposure time may lie anywhere in the range from 15 seconds to 8 minutes, depending on the specific process. To attain maximum reliability, the best or optimum exposure in this range must be found with respect to the over-all process. This is second in importance only to the initial steps of preparing the coating surface for maximum adhesion.

DETERMINING OPTIMUM EXPOSURE

Optimum exposure can be determined very easily as follows: One or more test panels are prepared and sensitized by using the identical steps established for circuit production, with one exception. Instead of a single exposure, a series of progressively doubled exposures are made from the circuit negative or positive on different areas of the test panels. Then the test panels are developed and etched or electroplated just as if they were production panels.

Inspection of the finished panel should reveal a series of acceptable circuit areas (Fig. 4). The optimum exposure for the process corresponds to the middle of this series. The extent of the range of satisfactory exposures indicates the amount of latitude present in the over-all process. Thus, exposure can be fixed and maintained at the optimum level. The reproducibility of the processing latitude on a series of test panels or on a production run will indicate how well fluctuations of other variables in the process are being controlled.

DEVELOPING THE RESIST IMAGE

When an exposed coating is developed in suitable organic solvents, the unexposed areas dissolve completely, leaving the exposed resist image on the coating surface. The image can be developed in a mixture of selected solvents* at room temperature with infinite latitude. That is to say, while the image requires a minimum development time of two minutes, it remains unharmed by overdevelopment for many hours.

With ordinary service in a narrow-mouth tank to minimize solvent-evaporation losses, the strength of the developer does not become exhausted, because some of it is carried out of the tank on each panel that is developed, and addition of fresh developer to maintain the level in the tank is sufficient to replenish the developer activity. Of course, contamination with water or other solvents must be strictly avoided.

Where speed, economy, and reliability in developing large quantities of photoresist image are desired, the use of trichloroethylene solvent in a commercial vapor-spray degreasing machine is recommended. The degreaser is a self-contained unit, charged with solvent which can be recycled indefinitely. All contamination by dissolved resist is confined to the sump and requires only occasional removal from the unit. The work is always developed in freshly distilled solvent and pure, hot solvent vapor; and emerges from the degreaser warm, dry, and ready for the next operation.

A dye bath† of the type intended for the photoengraver can be used to dye the resist image black for visual inspection, so that tone values at intermediate etching stages can be judged in truly "craftsmanlike" manner. Aside from its use in the preparation of printed-circuit prototypes, however, the dye bath is unnecessary in a production process designed for maximum reliability. In other words, if every effort has been made to control the process, it will be more economical to scrap the few random rejects that occur than to go to the expense of dyeing and inspecting the panels in order to salvage these circuits. This applies particularly to large panels containing multiple-circuit images.

ELECTROPLATING CONSIDERATIONS

The variety of chemical etching and electroplating processes to which photoresists have been applied has already been mentioned. Where a resist is to be used in a plating operation, a few guiding principles are worthy of consideration. Generally, a waterproof resist provides a greater margin of reliability than can be expected from the water-sensitive type. It has the advantage that the electroplating cycle can usually be established to provide optimum plating characteristics without the need of any compromise to favor limitations of the resist. Instead, it is usually possible to adapt the resist to an optimum set of plating conditions by any of several means, including special chemical surface treatments prior to coating the resist or a modified drying or resist-image baking cycle.

Of course, an organic resist image can withstand acid plating baths better than alkaline cyanide baths for the same reason it adheres better to an acidified metal surface. Alkaline baths tend to react with the metal surface and creep in laterally from the edges of the resist image. As a result, the image is undermined and is likely to strip off of the metal surface. Where plating from a cyanide bath is necessary, however, the adhesion of the organic-soluble resist to copper under these conditions is improved by carefully dissolving 6 grams of ammonium thiocyanate in each liter of resist used for this purpose (90 grains per quart). The amount is critical and should be carefully controlled, however.

Maximum adhesion of a surplated metal to the base metal

* Kodak Photo Resist Developer
† Kodak Photo Resist Dye.

is also essential. While the base metal must be scrupulously clean, the cleaning cycle used to prepare the surface for optimum resist adhesion may not prove ideal for adhesion of the plated metal. There will be few instances where one cleaning cycle will suffice for both operations. Moreover, the unexposed resist may not in all cases be removed completely down to clean base metal by the developer. An effective practice in this instance is to dip the panel bearing the developed resist image for fifteen seconds in a 20 per cent solution of ammonium persulfate in water at room temperature. This step has proved particularly beneficial in improving the adhesion of electro-solder or nickel to copper or beryllium copper surfaces.[1]

Where an electro-solder image is to serve as a resist for etching copper in a chromic-sulfuric acid bath, lead chromate stains on the finished circuit often present a problem. These stains can be avoided by dry-buffing the solder plate lightly before the panel is etched.

Removing the Resist Image

The remaining operation to be covered is that of removing the resist after it has served its purpose.

An exposed waterproof resist image will not redissolve in any known solvent. However, a number of solvents soften or swell the image sufficiently to permit its removal by scrubbing. Commercial cold-solvent, paint-stripper formulations, though relatively more expensive, will swell the image and "pop" it loose from the metal surface sufficiently to permit its removal by flushing with water. The use of these strippers will depend, however, on their effect on the surface resistivity of the insulator base material being used.

Where the physical characteristics of the circuit permit it, the resist can be removed by dry abrasion with a rotary power-driven, steel-bristled brush. In the case of ceramic-based circuits, the resist image can be "fired off" by heating to a temperature of 750–930F (400–500C).

Where the resist is to be used for etched copper circuits, it can be removed at the dip-soldering step. Up to this point, it protects the circuit through the various fabrication steps.

On fluxing and dip-soldering the final assembly, the resist strips automatically in the solder pot.

In tests to determine the reliability of this practice, bare-copper printed wiring and solder-plated printed wiring were compared with copper printed wiring protected by the exposed resist image. The three sets of circuits were dip-soldered while fresh, after aging in air, and after climatic-cycling in accordance with the JAN C-25 procedure. Acceptability of results was determined by physical inspection. Particular attention was paid to fillet formation and to any evidence that the solder did not readily adhere to the circuit.

All three types of boards were satisfactory when dip-soldered while they were still fresh. Of the samples aged in air, both resist-coated and solder-plated boards were satisfactory after three months. Boards with bare-copper conductors were satisfactory after twenty-five days but unsatisfactory after three months.

In the JAN cycling tests, resist-coated boards were marginal after seven days of cycling and unacceptable after fourteen days, while solder-plated boards were still satisfactory after fourteen days. But boards with bare conductors were unacceptable after one day. The results indicate that either the resist-coated or solder-plated circuits can be dip-soldered reliably after normal storage conditions of at least three months.

The principal factors affecting reliable removal of the resist in the solder pot include flux activity, solder-pot temperature, solder purity, and the extent of prefluxing the copper prior to coating with the resist.

SUMMARY

A photoresist printed-circuit production cycle designed for maximum reliability should include the following steps: Complete removal of organic residue from the copper surface; removal of inorganic oxidation by dipping in dilute hydrochloric acid; thorough washing and drying in forced hot air; immediate application of an organic soluble resist at room temperature by dip or spray techniques; initial drying at room temperature until the coating is "set," then a final drying in forced hot air; exposure of the panel in vacuum contact with the circuit transparency for the predetermined optimum exposure time; and development of the resist image automatically in a vapor degreaser. For etched circuits, subsequent steps include etching in ferric chloride; washing and drying; blanking and punching the individual circuits; assembling components; fluxing; and dip-soldering to remove the resist and complete the circuit assembly.

For plated circuits, subsequent steps include a preplating dip in ammonium persulfate solution, additional acid cleaning treatment as required, the electroplating operation, removal of the resist by scrubbing with solvent or by treatment with a cold paint stripper, removing unwanted copper in a chromic-sulfuric acid etch bath, postfabrication and component assembly, and dip-soldering to complete the circuit assembly.

No statement or suggestion in this paper is to be considered as a recommendation or inducement of any use, manufacture or sale that may infringe any patents now or hereafter in existence.

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Werter P. VanDeusen was born in 1922, received a BA in organic chemistry from Princeton University in 1942 and joined the Research Laboratories, Eastman Kodak Company, Rochester 4, N. Y. During 1944–1946, he worked on the Manhattan Project at the Tennessee Eastman Corporation plant, Oak Ridge, Tennessee. He returned to Rochester and the Eastman Kodak Company in 1946 where he is currently employed as a senior research chemist in the field of graphic arts.

SALT SPRAY TESTING OF TINPLATED COPPER

1. Corrosion Measurement by Chemical Porosity Test

by MARTIN S. FRANT*

A new method, based on a chemical porosity test, is reported for quantitatively evaluating the corrosion of tinplated copper. It is believed that the technique can be used for measuring corrosion under a variety of conditions. In the salt spray, corrosion was found to decrease as the logarithm of the tinplate thickness. After an initial period, the rate of corrosion is of parabolic form: $C = Kt^n$ (where K is a constant, t = time, n is approximately 2). Similar values of n were observed in salt spray tests to which acetic acid and borax were added. Reflowing the tin coating was found to increase the corrosion-resistance of "thin" tinplate, but decrease the resistance of plates heavier than 0.1 mils.

ALTHOUGH THE SALT-SPRAY TEST is one of the most widely used methods of testing electroplated parts, there is considerable opposition to its use in specifications.[1] As a research tool, it has two drawbacks—very little is known about the corrosion mechanism in salt-spray, and therefore correlation of salt-spray results to service conditions is uncertain; the method of evaluation, whether depending on time of first rusting[2] or exposure of basis metal within a certain period of time,[3] varies with the observer. Most descriptions and specifications devote considerable space to the physical variables involved in the test, while the exact method of evaluation is mentioned only briefly and in ambiguous terms. A United States Government specification,[4] for example, permits the use of an undefined "light brushing" before examination.

The principal objective methods suggested in the literature are weight loss determinations[5] and, for electrical connections, resistance measurements. The former method measures two competing tendencies: a weight increase due to oxide formation, and a weight loss as the oxide is converted to soluble complexes. The latter method is affected by the presence of surface films and oxidation at the contact areas, and so does not measure only the loss of the plating.

In order to learn more about the mechanism of corrosion of tinplated copper in the salt-spray, it was necessary to develop an objective evaluation test. The chemical porosity test of Schuermans and Blumenthal[6 a, b] appeared to be promising. It can be used for tin or nickel on either copper or brass. The principle is quite straightforward. The tinplated sample is immersed in a reagent which dissolves copper but not tin. They used ammonium hydroxide and ammonium persulfate, and the characteristic blue color of the copper ammonium complex served as the indicator. We have followed this procedure, but have adapted it for use in determining corrosion damage. The difference in porosity (or more precisely, copper surface available to the reagent) before and after the exposure to salt-spray is used as a measure of the corrosion. In practice, the initial porosity is usually smaller by a factor of several hundred than the porosity at the end of test, and often only the final porosity need be considered.

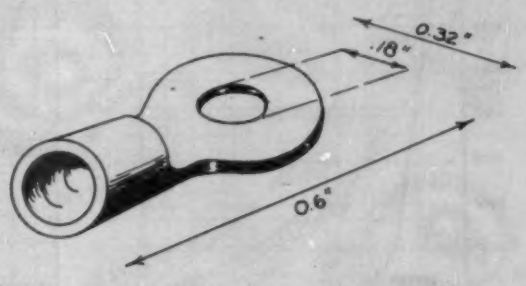
In the present paper, the correlation of visual results with the porosity test is shown, and examples are given of its use in determining corrosion rates, in comparing various types of salt-spray, in determining the effect of plating thickness on corrosion resistance, in comparing different plating solutions, and the effect of reflowing (melting) the tin coating.

Although all of the data in this paper are concerned with salt-spray damage, it is believed that the porosity test can also be used to measure corrosion rates in a wide variety of environments, thus eliminating the variable introduced by differences in subjectively evaluating the extent of corrosion.

EXPERIMENTAL

Tinplated Copper Specimens. The salt-spray tests were run in three different boxes. The first was a large box (approximately 72 cu ft) manufactured by the Industrial Filter and Pump Co.; the second, manufactured by the same company, was approximately half the size of the first; and the third was a small box made in our own laboratory, having a volume of about 5 cu ft. The salt solutions were prepared from distilled water and 99.5 per cent pure sodium chloride. The tests were run in either 4, 5 or 20 per cent solutions, as indicated in the results. In general, 8 sets of 10 specimens were used for each point on a graph.

The specimens were stamped from electrolytic copper and barrel-plated in an alkaline stannate or acid fluoborate bath. Each specimen (see Fig. 1) was about 0.6 in. long, and had a surface area of about 0.38 sq in. The plating thicknesses were determined with a Norelco X-ray spectograph Type No. 52157A, by measuring the copper K-alpha absorption in the fluorescent radiation.[7] After removal from the salt-spray the samples were washed in warm water to remove any salt, dipped in alcohol, and then air-dried. In those experiments in which the corrosion was so severe as to produce copper salts on the



TEST SPECIMEN

Fig. 1

* Research Division, AMP Incorporated, Harrisburg, Pa.

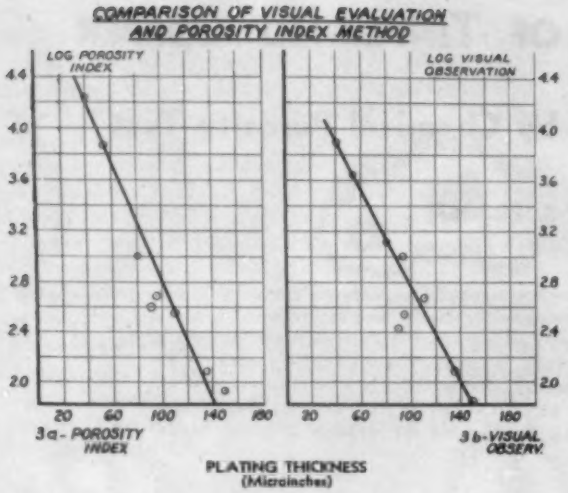


Fig. 2

surface of the specimens, a brief preliminary washing in 3 per cent ammonium hydroxide was used.

Sets of 10 specimens each were placed in a 125 ml Erlenmeyer flask, and 25 ml concentrated ammonium hydroxide and 25 ml 1*M* ammonium persulfate were added from separate burettes. The flasks were then placed on a low speed reciprocating shaker (A. H. Thomas No. 8917A) and agitated for exactly 30 min. The shaker was adjusted so that the solution was rocked gently, but the specimens did not rub or abrade. At the end of the 30-min period the solutions were decanted and stored in a refrigerator until analysis. In this work, the amount of copper in the solution[8] was determined using the Beckman Model DU at 580 mμ, and reported as ppm cupric ion per sq in. of tin surface. The copper-ion concentration determined in this manner varies as the available copper surface of the test specimen, but it cannot be related to an exact determination of the total exposed area because a diffusion process is involved, and the size of the "holes" becomes a factor. Because of this, and because the effect on the porosity test of changing the specimen configuration has not been studied, it was felt to be preferable to report the data in terms of a relative porosity. For this reason, the term *Porosity Index* is used in this work to report the amount of corrosion as ppm of copper per sq in. of tinplate surface (in contact with excess ammonia-ammonium persulfate) under the conditions described above.

RESULTS AND DISCUSSIONS

Plating Thickness vs. Corrosion. In an experiment to determine the effect of plating thickness on amount of corrosion, a group of 650 specimens of varying thickness were plated in a sodium stannate bath,[9] and randomly distributed in a salt-spray box. The test was run for 100 hrs using 20 per cent sodium chloride solution. At the completion of the test, the samples were rated on an arbitrary 0-5 scale, where 5 was "failure" (exposure of basis metal) and 0 was no visible corrosion. The results (shown in Fig. 2) indicated that the data best fitted an equation of the type:

$$\text{Log corrosion} = K \times \text{thickness} + K_o$$

The porosity was then determined and the data plotted. As can be seen, the same type of equation is obtained; in fact, many of the points fall on the same side of both lines. The porosity plot shows only the final porosity, since the initial porosity was essentially zero for coatings thicker than 40 micro inches. See Fig. 3.

Both methods of evaluation confirmed what the electroplater has always known—that increasing the thickness of tinplate increases the corrosion resistance—but it also clearly shows as a consequence of a logarithmic relationship, that doubling the salt spray resistance (as measured by the porosity test) does not require twice as much tin.

The concept that the protection afforded to the copper depends on the thickness of tin can be shown in a somewhat different manner. A group of specimens was barrel-plated in an acid fluoborate bath,[10] and samples removed at various intervals. The plot of plating thickness vs. corrosion is shown in Fig. 4. It would appear that a considerably greater average thickness is needed for fluoborate-plated tin than for stannate-plated.

If an average thickness of 100 microinches of stannate-plated tin is needed to show practically no corrosion in 100 hrs

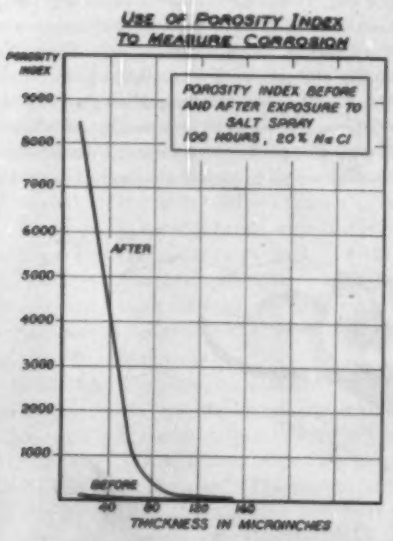

USE OF POROSITY INDEX TO MEASURE CORROSION
POROSITY INDEX
POROSITY INDEX BEFORE AND AFTER EXPOSURE TO SALT SPRAY 100 HOURS, 20% NaCl
AFTER
BEFORE
THICKNESS IN MICROINCHES

Fig. 3

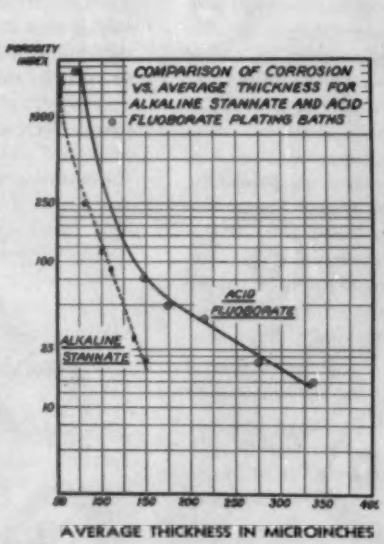

COMPARISON OF CORROSION VS. AVERAGE THICKNESS FOR ALKALINE STANNATE AND ACID FLUOBORATE PLATING BATHS
ACID FLUOBORATE
ALKALINE STANNATE
AVERAGE THICKNESS IN MICROINCHES

Fig. 4

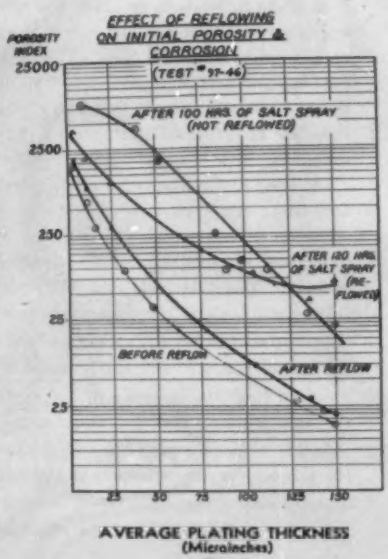

EFFECT OF REFLOWING ON INITIAL POROSITY & CORROSION
(TEST "37-46)
AFTER 100 HRS. OF SALT SPRAY (NOT REFLOWED)
AFTER 100 HRS. OF SALT SPRAY (RE-FLOWED)
BEFORE REFLOW
AFTER REFLOW
AVERAGE PLATING THICKNESS (Microinches)

Fig. 5

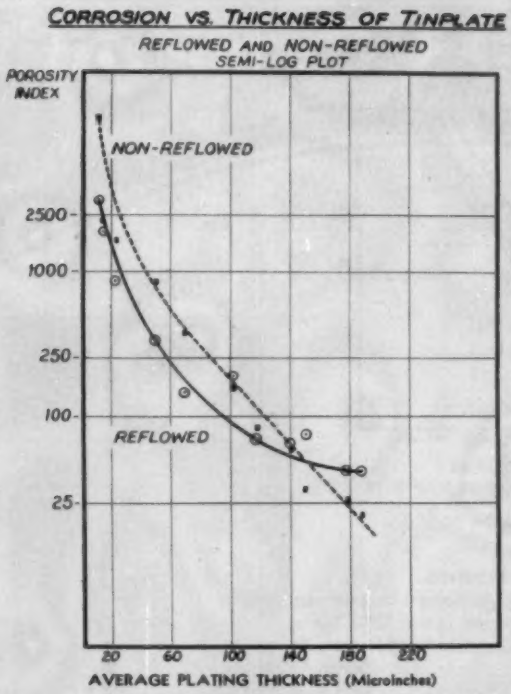


Fig. 6

of testing, it is found that an average thickness of about 150 microinches of fluoborate-plated tin is needed on the same basis. However, the fluoborate bath is known to have considerably less throwing power, and this results in a wider distribution (or range) of thickness for any average value in barrel plating. If, instead of the average value, the minimum thickness at the one per cent level (i. e. when only one per cent of the specimens have less than the given thickness of tin) is determined from probability considerations, then the specimens from both baths require the same minimum quantity—about 50 to 60 microinches. This leads to the conclusion that, insofar as corrosion is concerned, there is little difference in the inherent quality of the tin from either bath.

Effect of Reflowing. Electrolytic tinplate in commercial practice is usually briefly heated above the melting point of tin to produce a fused or "reflowed" plate. This produces a bright finish, and for tinplate on steel, is reported to give improved corrosion resistance.[11] To determine if this situation also applied to tinplated copper, half of a set of specimens of various tinplate thickness was reflowed at 250C in hydrogenated vegetable oil, cleaned, and the entire set placed in the salt spray.

Fig. 5 shows that reflowing appears to cause a uniform, moderate increase in the initial porosity. Nonetheless, for "thin" tinplate (less than, say, 100 microinches), reflowing appears to improve the performance. Notice, in Fig. 5, that 100 hours for the non-reflowed is more severe than 120 hours for the reflowed specimens. A test on a different set of specimens exposed simultaneously for 150 hours produced the results shown in Fig. 6. The same probable improvement can be seen for reflowed "thin" tinplate, and the same type of crossover with probable superiority for "thick" non-reflowed tinplate.

The Corrosion Rate vs. Time of Exposure. In another series of tests the rate of corrosion was studied as a function of salt spray exposure time. The test specimens were plated

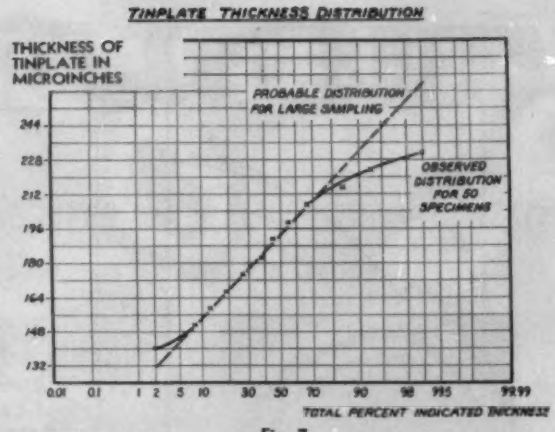


Fig. 7

to a thickness in common industrial use (200 microinches). A single barrel may contain thousands of individual pieces, and at the end of any interval of time, tin thickness varies from piece-to-piece in a normal distribution. The distribution of thickness for a group of specimens used in many of these tests is shown in Fig. 7. By using a large number of small samples from the same plating barrel, it is possible to obtain far more reproducible samples than if individually plated specimens were prepared for each test.

It was found that, regardless of the particular test box used, or the concentration of sodium chloride solution chosen, all the data could be described as follows:

The initial phase, which varied from test to test, but generally was less than 40 hrs, and could be described by an equation of the form:

$$C = K^t + K_o \quad (t = \text{hours of exposure})$$

This gradually changed to **the second phase,** which could be described by an equation of the form:

$$C = K_1 \cdot t^n$$

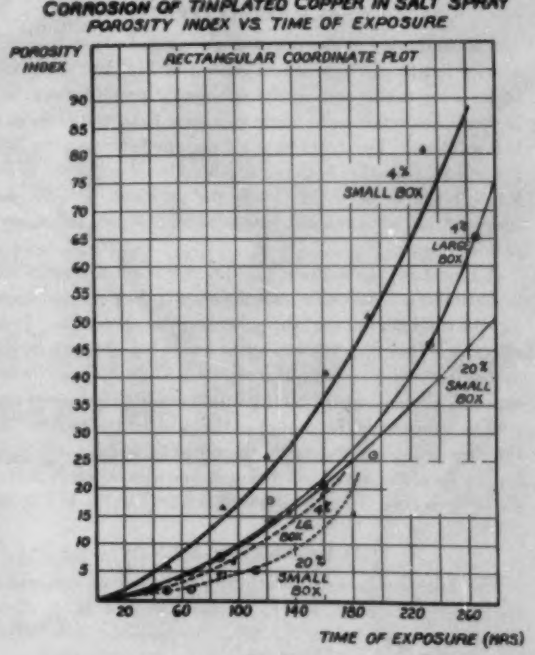


Fig. 8

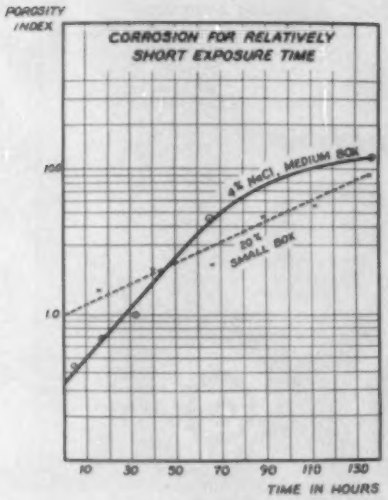


Fig. 9

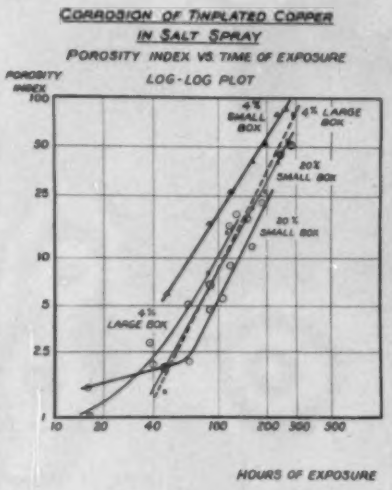


Fig. 10

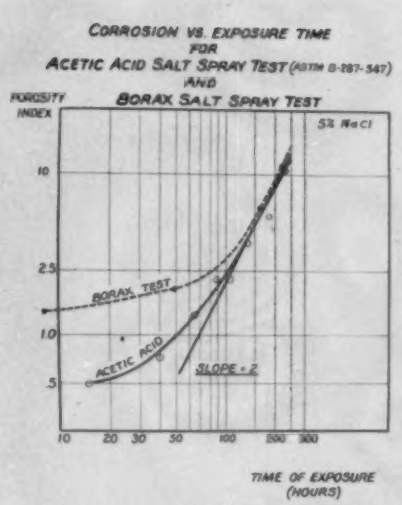


Fig. 11

where n generally was about 2. The rate therefore can be expressed as:

$$\frac{dC}{dt} = K_1 t$$

The two rates are not apparent from a rectangular coordinate plot, such as Fig. 8, but are evident in some curves in Figs. 9 and 10. The former shows the initial period of corrosion, the latter the period of more general interest.

Once the initial phase is over, since the amount of corrosion increases as the square of time, a test of 140 hours is twice as severe as a test of 100 hr, and a test lasting 175 hr is three times as severe as a test lasting 100 hr. In practice, when "pass-or-fail" tests for control purposes are involved, the time of exposure must be watched carefully.

ACETIC ACID AND BORAX SALT SPRAY TESTS.

The similarity in the slopes of the second phase (mentioned above) led to the experiment shown in Fig. 10. The ASTM test[12] using acetic acid in the salt-spray is well-known, and is generally believed to be more corrosive than tests run in neutral solution. Two tests were set up, one following the ASTM procedure, the other with borax added to raise the *p*H to about 8.7. It will be seen that while the solutions have markedly different initial corrosion rates, after 150 hr the rates are almost identical.

A tentative explanation for the two corrosion rates would be as follows: The initial rate represents the period of decreasing tin thickness at certain points on the specimen. It is, in effect, a porosity measurement in which log porosity increases as the tin thickness diminishes. Once the copper becomes exposed, a linear rate of attack would cause the exposed copper area to increase as the square of the rate for the radius. Since the corrosion as measured by the porosity test is total exposed copper area, the actual corrosion in one dimension is probably linear with time.[13]

ACKNOWLEDGMENTS

The porosity test calibrations are based on unpublished work by G. T. Kerr, R. H. Zimmerman and H. A. Fox Jr. The analyses were run by Miss A. Imswiler and Miss N. Morelock.

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Martin S. Frant is a Research Associate at AMP Incorporated, working in the field of electrochemistry and corrosion. He received a BS (1949) in chemistry from Brooklyn College, and MS (1951) and PhD (1952) degrees from Western Reserve University. Before joining AMP in 1956, his previous industrial research experience was in the field of organomercurials and quaternary ammonium compounds. He is a member of the American Chemical Society, American Association for the Advancement of Scignce, Electrochemical Society, Chemists Club, and Sigma Xi.

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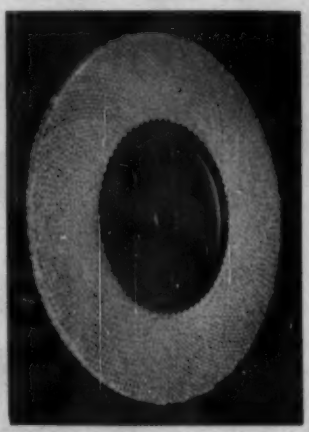

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The mall of Coney Island Amusement Park where the AES conventioning men, ladies and children will enjoy themselves on Tuesday afternoon, May 20.

45th ANNUAL CONVENTION: A PREVIEW

UNDER THE LEADERSHIP of Convention Chairman Charles Wise and Co-Chairman Ezra A. Blount, committee chairmen of the Cincinnati Host Branch for the 45th Annual Convention of the American Electroplaters' Society are working like rocket scientists to iron out the details of what is shaping up to be a versatile and appealing educational and social program. Have a preview look.

Registration: Get-Together Party

Platers and their wives will begin registering for the National Convention on Sunday, May 18. Stewart Chipman, entertainment chairman, has announced that, to get things rolling, the Annual Get-Together Party will launch the convention on Sunday evening, May 18, 1958. Music, dancing and refreshments will add to the gaiety of renewing old acquaintanceships.

Opening Day's Many Events

Convention Chairman Wise will wield the gavel for the official opening of this convention on Monday morning, May 19. The first Business Session of the Supreme Society will immediately follow with National President Francis T. Eddy himself presiding.

Early that afternoon, first speakers of the Educational Sessions will present four of the 25 or more technical papers that will be delivered during the convention. Authors now in the process of preparing papers for this convention are experts in their fields, well qualified to probe technical problems and discuss new developments. Educational sessions will be held every day throughout the week.

Monday's social highlight will be the Open House sponsored by the Metal Finishing Suppliers' Association (MFSA). All conventioneers are invited to this party, which is to be held in the evening, complete with music, dancing and refreshments.

Tuesday: Golf Party and Outing

Tuesday is scheduled to be a busy day. Morning Educational Sessions will be followed by the MFSA golf tournament for the divot diggers at Kenwood Country Club, and an outing for the whole family at Coney Island Amusement Park, planned by Arthur Gerada, outing chairman. Here is one of the nation's largest and best loved amusement parks. Located on the Ohio River, a short distance from Cincinnati, it includes the world's largest recirculating swimming pool, which will be open to aquatic-minded platers and their families. There will be rides of all kinds, from screaming roller coasters to the newest rocket ships. There will be miniature golf and pleasant picnic areas. A buffet luncheon will be served at about 1:00 p.m.

Wednesday: More Education; Show and Dance

Wednesday will be the big day for technical sessions. Dual educational programs are scheduled for both the morning and afternoon. But platers will be allowed to toss away their technical troubles (temporarily, at least) in the evening while watching a top-flight floor show and then dancing in the hotel ballroom.

Thursday: Business Then Parting Banquet

On Thursday, Delegates will transact weighty Society business at the Annual Meeting. Elsewhere, platers will attend the panel session on practical plating problems. And that evening, the Annual Banquet and Dance will be held, after which the weary plater will pack up his clothing, his wife, and the information he has gained and head back for the land of tanks and racks to practice what he has learned during a busy but profitable convention.

Park-like grounds and the entrance to the plant of Cincinnati Milling Machine Co. A tour of this plant has been arranged during the AES 45th Annual Convention.

THREE TOP PLANTS TO WELCOME AES VISITORS

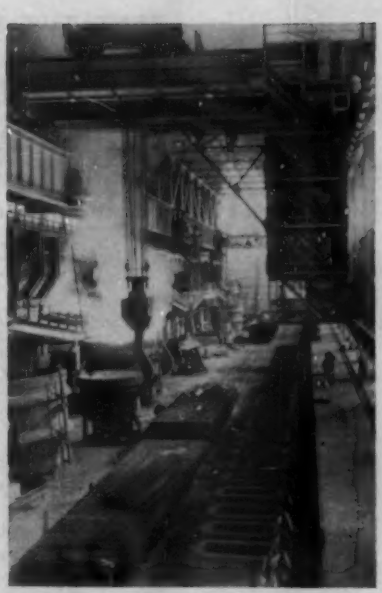
Arranged by Ray Barry, chairman of the Plant Visitation Committee, three appealing educational plant tours will be conducted during the Cincinnati Convention (dates to be announced) namely:

Cincinnati Milling Machine Co.

The first of these tours will take interested platers through the plant of the world's largest machine tool manufacturer, Cincinnati Milling Machine Company. It manufactures milling machines, broaching machines, cutter and tool grinders, special machine tools, metal-forming machines, hardening machines, cutting fluid and grinding wheels. Metal cutting, metal forming, foundry and heat-treating, as well as finishing operations, will be seen on this tour.

Armco Steel Corporation

The second tour will find the conventioneers getting an education in steelmaking as they go through Armco Steel Corporation's plant in Middletown, Ohio. This is indeed a worthwhile experience, showing steelmaking from the dramatic view of a furnace and the shower of sparks in tapping, through the rolling operations where the long red-hot slabs travel at express train speeds, getting thinner and thinner as they go, and finally rolling up into a coil in one continuous operation; then through the shearing, trimming and heat-treating operations; and finally through Armco's modern facilities for applying their patented hot-dip galvanized coating, "Zincgrip."



Open hearth furnace at Armco Steel Corp's. Middletown works, near Cincinnati. Convention visitors will witness the molten steel being poured into a huge ladle and then into the ingot moulds lined up in the foreground.

Electric Auto-Lite Company

The third tour will take the platers through the largest plating installation in the Cincinnati area, the Electric Auto-Lite Company's bumper plant. Those who take advantage of this tour will be rewarded by seeing a plant that has rapidly expanded in recent years, becoming more and more automatic with each expansion. This plant is an excellent example of a large top-flight plating installation, making use of the most modern equipment and techniques to produce quality bumpers in quantity.

Vas you efer in Zinzinnati plants? View these. *You'll be so glad you did!*

CONVENTION FARE FOR THE LADIES

Wives who attend the 45th Annual Convention in Cincinnati will be as busy as hubby during this Spring-time week. Beside attending the banquets, parties and luncheons, the ladies will want to tour Cincinnati's many cultural attractions and take a sightseeing tour of the breathtaking hilltop views of the City of Seven Hills.

During the first day of the convention, while the men are attending to business, the ladies will be entertained at the Aunt Ella Luncheon, sponsored by Oakite Products, Inc., to be held in one of Cincinnati's newest and finest eating places, the Colony Restaurant in Swifton Shopping Center. Immediately following the luncheon, the ladies will attend a style show at nearby Rollman's.

On Tuesday, the ladies will play golf in the morning at Kenwood Country Club then attend the outing in the afternoon at Coney Island.

Noontime Wednesday will find the ladies at a luncheon sponsored by *Products Finishing* magazine in the Roof Garden of the Sheraton-Gibson. An audience-participation program will be featured at this luncheon.

The ladies will climax their part of the program with the annual Plato Party, sponsored by the Udylite Corporation, at noon on Thursday in the Pavilion Caprice of the Netherland-Hilton Hotel. And of course they'll go to the banquet on Thursday evening to celebrate the end of a successful convention. Yah, it vill be fun to be in Zinzinnati in de Zpringtime!

Convention Hotel Reservation Form will be published in the March Issue of PLATING

TENTATIVE PROGRAM

45th ANNUAL CONVENTION
AMERICAN ELECTROPLATERS' SOCIETY, INC.

Hotel Sheraton-Gibson, Cincinnati, Ohio
May 18-22, 1958

As prepared by the Cincinnati Convention Committee and approved by the Executive Board, this is the TENTATIVE program as of January 1, 1958. Additions and modifications will be carried in the March issue of PLATING.

SUNDAY, MAY 18

10:00 a.m.	Executive Board Meeting
2:00 p.m.	Trustees' Meeting, Metal Finishing Suppliers' Assn. (MFSA)
4:00 p.m.	Credentials Committee
8:00 p.m.	Get-Together Party

MONDAY, MAY 19

10:00 a.m.	Opening Session
11:00 a.m.	Business Meeting, Supreme Society
12:00 noon	Luncheon Meeting, (MFSA)
12:00 noon	Branch Secretaries' Luncheon
12:00 noon	Ladies' Luncheon
12:15 p.m.	Speakers' Luncheon
2:00 p.m.	First Educational Session
2:30 p.m.	Editorial Board Meeting
6:30 p.m.	Past Presidents' Dinner
9:00 p.m.	Open House (MFSA)

TUESDAY, MAY 20

8:00 a.m.	Membership Committee Breakfast
8:00 a.m.	Speakers' Breakfast
9:00 a.m.	Second Educational Session
10:00 a.m.	Public Relations Committee Meeting
10:00 a.m.	Other Committee Meetings (to be scheduled)
12:00 noon	Outing at Coney Island
12:00 noon	Golf Tournament at Kenwood Country Club (MFSA)

WEDNESDAY, MAY 21

8:00 a.m.	Research Committee Breakfast
8:00 a.m.	Speakers' Breakfast
9:00 a.m.	Third Educational Session
9:00 a.m.	Fourth Educational Session
9:00 a.m.	Research Committee Meeting
9:00 a.m.	Educational Committee Meeting
12:00 noon	Branch Librarians' Luncheon
12:00 noon	Ladies' Luncheon
12:00 noon	Speakers' Luncheon
2:00 p.m.	Research Committee Meeting
2:00 p.m.	Fifth Educational Session
2:00 p.m.	Sixth Educational Session
9:30 p.m.	Floor Show and Dance

THURSDAY, MAY 22

8:00 a.m.	Speakers' Breakfast
9:00 a.m.	Seventh Educational Session (Panel: "Practical Plating Problems")
9:00 a.m.	Business Meeting, Supreme Society (All Day)
12:00 noon	Ladies' Luncheon
2:00 p.m.	Ladies' Party
7:00 p.m.	Banquet and Dance

CONVENTION PAPERS

At its Cincinnati meeting, February 26, the Editorial Board will select and approve the technical papers to be delivered before the 45th Annual Convention from among these now being finalized:

1. EFFECT OF SHOT-PEENING PRIOR TO CHROMIUM PLATING ON THE FATIGUE STRENGTH OF HIGH STRENGTH STEEL
2. ELECTROLYTIC PREPARATION
3. LOOSE ABRASIVE FINISHING
4. AES PROJECT NO. 14—MECHANICAL POLISHING OF THE BASIS METAL AND ITS EFFECT ON THE CORROSION RESISTANCE OF A WATTS NICKEL DEPOSIT
5. HARMFUL EFFECTS AND TREATMENT OF IMPURITIES IN SEWAGE
6. THE USE OF BIOASSAYS IN THE SAFE DISPOSAL OF ELECTROPLATING WASTES
7. ION EXCHANGE AND THE PICKLING OF MAGNESIUM SHEET
8. INDUSTRIAL WASTE TREATMENT AND WATER RECLAMATION
9. PRINCIPLES OF ELECTRO-CHEMISTRY
10. CLEANING, PICKLING AND PREPARATORY SURFACE TREATMENT
11. TYPICAL PLATING SOLUTION—CYANIDE ZINC
12. FACTORS AFFECTING THE CHARACTER OF ELECTRODEPOSITS
13. PLATING ROOM POWER
14. ENGINEERING AND INSTALLATION IN THE PLATING ROOM
15. PLATING RACK—DESIGN AND INSULATION
16. THE ROLE OF ACCELERATED TESTS IN THE PAINT FINISHING FIELD
17. USE OF PLASTISOLS AND ORGANISOLS AS DECORATIVE FINISHES
18. WHEN AND HOW TO SELECT AN ORGANIC COATING
19. CLEAR FINISHING OVER COPPER, ZINC, BRONZE, CHROME, ETC.
20. SOME COMMON CAUSES OF PREMATURE PAINT FILM FAILURE
21. HARD ANODIZING OF ALUMINUM
22. ELECTRODEPOSITED METALLIC AND FLAME SPRAYED CERAMIC COATINGS FOR ELEVATED TEMPERATURES
23. A METALLURGICAL APPROACH TO RESIDUAL STRESS IN ELECTRODEPOSITED METALS
24. ALLOY PLATING SYSTEMS FOR AIRCRAFT ENGINES
25. PITTING IN HARD CHROMIUM PLATING
26. NI-CHEM
27. INSTRUMENTATION
28. BRONZE ALLOY PLATING
29. DECORATIVE CHROME PLATING
30. PATTERN PLATING WITH ELECTRODEPOSITS
31. (PRESENTLY UNNAMED)

●

PANEL DISCUSSION:
PRACTICAL PLATING PROBLEMS
Dr. Abner Brenner (Moderator)

PANEL MEMBERS:
PREPARATION OF BASE METALS: Dr. A. Kenneth Graham
CONVERSION COATINGS & MILITARY REQUIREMENTS: Lloyd O. Gilbert
CORROSION: Dr. Harold Read
DECORATIVE PLATING: (To be Named)
ANODIZING AND PLATING ON ALUMINUM: (To be Named)
SPECIALTY WORK, JOB SHOP OPERATION: H. F. Smith
ORGANIC COATING: (To be Named)

AES NEWS

F. O. Beuckman

H. L. Kellner

B. C. Case

PAPER AWARD SELECTION OCCUPYING STRONG COMMITTEE

With eight Paper Awards instead of the six of past years in contention, Chairman Henry L. Kellner and his 1957–1958 Paper Awards Committee cohorts, namely Frank O. Beuckman and Bernard C. Case, are at work studying PLATING and Convention papers from which ultimate selection for award will be made. Eligible in the competition are all Montreal Convention papers plus all technical papers published in PLATING from March 1957 through February 1958. The Committee is laboring against a March 15, 1958 deadline, with actual announcement of winners to be made at the First Business Session of the 45th Annual Convention in Cincinnati, May 19, 1958.

The highest award is, of course, the Carl E. Heussner Award AES Gold Medal. Under the Award structure liberalized by the Supreme Society last June, that Award now has a cash value of $250 plus a gold medal. The new Silver Medal for second best PLATING or Convention paper has a cash value of $150—the Bronze Medal for third best paper provides for a $50 cash award.

The rest of the Awards' array includes the George B. Hogaboom Award for the best nickel plating paper; the Robert S. Leather Award for the best contribution on mechanical finishing; the Chromium Plating Award and the Precious Metal Plating Award. These four high Awards are respectively sponsored by the Hartford Branch, Lea Manufacturing Company, Nutmeg Chrome Corporation and Technic, Inc. Aside from a certificate, each has a $50 cash value except the Hogaboom Award whose cash award is $75.

The eighth Award, namely the new John J. Hanney Memorial Award of the Grand Rapids Branch and Metal and Thermit Corporation, has just been approved by the Executive Board as reported elsewhere in this issue of PLATING.

R. J. Hazucha

HAZUCHA COMMITTEE STUDYING MERIT AWARD STRUCTURE

A six-man Committee has been appointed by National President Francis T. Eddy to study the needs and means of improving the eligibility standards, manner of selection and other such policy and procedure with respect to the Society's media for recognizing outstanding Society service and performance, namely its Honorary Memberships and its Awards of Merit.

Heading that Committee is Rudolph J. Hazucha of Chicago, himself an Award of Merit winner. The Committee will report its findings and recommendations to the Executive Board for ultimate consideration and action by the Supreme Society at its coming Cincinnati Annual Meeting.

The proposal for such a study was originated by the Baltimore-Washington Branch. Its suggestion was heard at the Supreme Society meeting in Montreal, June 20, 1957, and channeled to the Executive Board for action.

Beside Chairman Hazucha, the Committee includes William V. Coleman of Waterbury; Past Presidents Frank C. Mesle of Sherill, New York and Edward J. Musick of St. Louis; plus Thomas A. Trumbour of Westwood, N. J. All except Mr. Coleman are themselves Honorary Members.

R. E Harr

HARR NAMED SCIENTIFIC AWARD COMMITTEE HEAD

Dr. Russel E. Harr of Chicago has been elected Chairman of the Scientific Achievement Award Committee and will lead that Committee in the selection of the Society's first "AES Scientific Achievement Award" winner. The Committee will choose that initial winner of the AES highest award from among the nine candidates nominated by AES Branches, and his identity will be announced at the 45th Annual Convention in Cincinnati in May 1958. He will deliver the "William Blum Lecture" at the Detroit Convention in 1959, and will receive both a scroll and a $500 cash honorarium.

President of the Chicago Branch, Dr. Harr is currently also Vice Chairman for Research of the Research Committee and is a stalwart of the Editorial Board. A graduate of the University of Wisconsin, he is associated with the Western Electric Company in Chicago as a chemical engineer. He and A. G. Cafferty of the same company garnered the Precious Metal Plating Award in 1957 by the excellence of their paper, "Gold-Silver Alloy Plating", delivered before the Washington Annual Convention in June 1956.

The balance of this high-honor Committee includes Dr. Abner Brenner, Leslie L. Diveley, Dr. Samuel Heiman, Leland M. Morse and Dr. Edward A. Parker.

John J. Hanney

AES's NEW EDUCATIONAL COMMITTEE LAUNCHED—Spearheaded by First Vice President Herberth E. Head, the new Educational Committee inaugurated by the Supreme Society by Bylaw amendment at Montreal last June was organized formally at a meeting in Newark, Saturday, December 14, 1957. Above, left to right, Dr. John Kane, Chairman Dodd S. Carr; Mr. Head and Ralph A. McCahan, Committee members present at the Newark Branch meeting the prior evening. Other Committee members include Edward C. Bertucio, Myron Ceresa, Rafael Diaz, Dr. Harold J. Read, William P. Wisdom and Dr. Ernest J. Wilhelm.

SPECIFICATIONS FOR HANNEY AWARD APPROVED

The specifications of the John J. Hanney Memorial Award presented by the Grand Rapids Branch to the Executive Board in Indianapolis, January 11, having been approved by the Board, that paper award is now finalized and will be one of the eight such approved AES Paper Awards to be vied for by PLATING and Convention technical paper authors this fiscal year. It was authorized by the Supreme Society at its Montreal meeting last June.

Memorializing the late John J. Hanney, a stalwart of the Society and of the Grand Rapids Branch, and sponsored jointly by the AES, its Grand Rapids Branch and the Metal & Thermit Corporation, the Award will be given to the best PLATING or Convention paper during the 1957–1958 fiscal year on the subject of copper plating. Beside handsome certificates, the awardee or awardees will receive or share a $75 cash award.

The Metal & Thermit Corporation's co-sponsorship of the award stems from that company's respect for the late Mr. Hanney as a long-time employee of that company.

The Grand Rapids Branch delegation that finalized plans with the Executive Board was composed of Branch President Richard O. Watson and Delegates Chester G. Borlet and Donald Smith.

Inadvertently, the Branch Directory included on Page 96 of the January 1958 issue carried the date of January 1, 1957. The correct date is January 1, 1958.

F. C. Mesle

MESLE RETIRES: 60 YEARS WITH SAME COMPANY

Following over six full decades of devoted service as an employee of the Oneida, Ltd., Co., Frank C. Mesle, a Past President of the AES, retires from active service late this month. For several years, he had been the oldest employe still working for that company.

Mr. Mesle entered Oneida's employment at the age of thirteen starting as an errand boy. In Horatio Alger pattern, he progressed through the years from scrub boy to foreman to plating consultant, finally to industrial engineer. During World War II, he organized the bearing plating department. Since the end of the Korean War, he worked on various assignments in the Works Laboratory.

Also an ordained minister serving a small congregation in Sherrill, N. Y., Mr. Mesle has, in addition, had a distinguished record of American Electroplaters' Society service. He organized the first Buffalo Branch of the AES. He earned the Society's Founder's Gold Medal four times. For two years (1923–1925), he was the editor of "The Monthly Review," predecessor of PLATING Magazine. For years, he was a member of the Research Committee. He has attended every Annual Convention to date except the 1932 meeting, and has rendered the opening Invocation at most such assemblies.

TWO-DAY ANNUAL SESSION FOR SOUTHEASTERN BRANCH

Southeastern Branch will hold its Third Annual Technical Session at the Dinkler-Plaza Hotel in Atlanta, Georgia on Friday and Saturday, February 14 and 15. Miami and Blue Ridge are participating in the sessions.

Howard Bone is the general chairman. Educational Chairman Wilmont D. Tidd will present five technical speakers: R. V. Vanden Berg of the Aluminum Co. of America, Dr. Richard B. Saltonstall, Udylite Corp.; Clarence H. Sample, International Nickel Co.; Henry Mahlstedt, Metal and Thermit Corp. and Walter Pike of Hanson-Van Winkle-Munning Co. In addition to this group of prominent speakers, a tour of the Scripto plant has been arranged.

Entertainment is in the capable hands of Justis U. Belville. A complete Ladies Program has been planned.

The Executive Board will be represented by two national officers: President Francis T. Eddy and First Vice President Herberth E. Head.

DIGGIN AND BARRETT AT CLEVELAND BRANCH ANNUAL

A special technical session will be held on Saturday afternoon, February 15, 1958 prior to the Annual Dinner-Dance of the Cleveland Branch. The meeting will be held from 1 to 4 p. m. in the English Room of the Hotel Carter, Cleveland.

Serving as chairman of the session will be Dr. W. Andrew Wesley. Myron Diggin of Hanson-Van Winkle-Munning Co., will speak on Nickel Plating. Another speaker will be Richard Barrett of Barrett Chemical Products. His subject will be Sulfamate Nickel.

The Dinner-Dance will be held later in the evening in the Rainbow Room of the Hotel Carter.

1962 CHICAGO EXPOSITION IN PRELIMINARY DISCUSSION

Chicago delegation (above) discusses preliminary plans for the 1962 Chicago exposition with the Executive Board, Indianapolis, January 11, 1958. Left to right: John P. Nichols; Dr. W. Andrew Wesley; Paul Glab, Chicago Branch Secretary; Dr. Russel E. Harr, Chicago Branch President; Francis T. Eddy; Past President Clyde Kelly (Chicago); Herberth E. Head; Dr. Samuel Heiman; Ralph D. Wysong.

SPECIAL BRANCH SUPPORT OF RESEARCH PROGRAM

The AES's active Research Program in various universities and foundations in the United States and Canada is being financed not only by the Sustaining Membership fees of a number of progressive American and Canadian companies but also by the allocation to the Research Fund, of the sum of a dollar per member per year of the annual membership fees paid to National Headquarters by Active Members and Members-at-Large.

As manifestation of their special interest in and devotion to that research program, three AES Branches have now initiated and have made separate and additional Branch contributions to that Fund above and beyond the dollar per member included for research in their $5.70 per member per-capita tax payment to the Society for the fiscal year 1957–1958.

These dedicated Branches are Central Michigan, Toronto and Western Ontario. Besides these, the Cleveland Branch has reportedly approved a $500 contribution to the Research Fund. The AES extends its hearty appreciation to these Branches.

McGAR RESIGNS FROM WATERBURY BRANCH

Benjamin H. McGar, soon to retire from Chase Brass and Copper Co., has tendered his resignation from Waterbury Branch, effective March 31, 1958. He has been a member of AES for over 30 years.

Mr. McGar's untiring efforts contributed greatly to the early success and growth of Waterbury Branch.

The Branch has expressed "appreciation for his contributions in the past and extends sincere wishes for a long, happy and rewarding retirement."

The National Society echoes the Branch's sentiments.

D. G. Foulke

BRANCH FISCAL YEAR TRANSITION COMMITTEE ACTS

At its Annual Meeting held in Montreal, June 20, 1957, the Supreme Society amended the AES's Constitution and Bylaws thereby altering the Society's fiscal year from April 1-March 31 to July 1–June 30.

For the purpose of studying and recommending to it, the most efficient and suitable procedure whereby Branch transition to the new fiscal year may be effected, the Executive Board authorized National President Francis T. Eddy to appoint a Committee of experienced Branch Secretaries for this purpose.

Dr. D. Gardner Foulke (Newark Branch) heads that Committee whose personnel, in collaboration with the National Executive Secretary, includes Ward Kelly (St. Louis Branch); Edward J. Kubis (Detroit Branch); I. William Marcovitch (Philadelphia Branch) and Robert G. Parker (Bridgeport Branch).

The Committee's final report has been completed and has had Executive Board study, finalization and approval. It has now been channeled to the Supreme Society by letter ballot for the consideration and action of Delegates, governors of the AES. Outcome will be reported in a subsequent issue of PLATING.

CLARENCE L. VAN DERAU

Clarence L. Van Derau died on Christmas Eve, 1957 after a brief illness, at the age of 67.

Mr. Van Derau was the last of the Charter Members of the Dayton Branch, AES, still on the membership rolls. He joined the Branch on July 2, 1913 and at that time was Plating Foreman at the Dayton Plating & Mfg. Co. He held many of the offices of the Branch and moved to Mansfield, Ohio to accept a job with Westinghouse Electric, in 1922. Even though considerably far away from Dayton, he always maintained his membership in Dayton. Many trips were made to Dayton to attend meetings.

Mr. Van Derau was an Honorary Member of both the AES and the Dayton Branch. He was National President of the AES in the trying economic depression years of 1933 and 1934, and, substantially through his untiring efforts, the Society survived the crisis.

In 1957, both the Mansfield Chamber of Commerce and the Chamber of Commerce of Ohio awarded him Life Memberships. The loss of such an esteemed man will be mourned by his many friends and fellow members of the AES.

—The Dayton Branch

In Memoriam

WHEREAS Clarence L. Van Derau, a member of the American Electroplaters' Society of long standing, gave devoted service to the Society and its objectives.

WHEREAS His leadership qualities earned him election to the Executive Board culminating in service as President of the Society.

WHEREAS His activities included out standing service as a member and officer of the Dayton Branch

BE IT THEREFORE RESOLVED that the Delegates assembled in Interim Meeting of the Supreme Society in Indianapolis this Eleventh Day of January 1958 do hereby record that Sorrow over his passing, and instruct the National Executive Secretary not only to spread that expression in the minutes of this meeting, but also to send a copy thereof both to the next of kin of the deceased and to the Dayton Branch.

Fifth Interim Meeting
Supreme Society of the
American Electroplaters' Society, Inc.

PATENT ABSTRACTS

DR. D. GARDNER FOULKE
Manager, Electrochemical Development
Hanson-Van Winkle-Munning Co.
Matawan, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,809,156, 10/8/57—Electrodeposition of Iron—W. Safranek, assignor to Rockwell Spring and Axle Co., Coraopolis, Pa.

A ferrous sulfate bath is claimed to which is added an organic compound selected from the group consisting of saccharin and phthalimide and a small quantity of wetting agent to provide a level and ductile plate. The deposition of iron alloys, e.g., nickel, is also described.

18 claims.

No. 2,809,422, 10/15/57—Making Composite Articles—H. Shultz, assignor to General Motors Corp., Detroit, Michigan.

A steel backing member (strip) is plated with copper (0.00002 in.) then brought into contact with an aluminum member (e.g. strip) and heated to 800F to 1010F in a non-oxidizing atmosphere and rolled to reduce the aluminum to 65–80 per cent.

4 claims, figure.

No. 2,809,423, 10/15/57—Brazing Aluminum—D. Hanink, assignor to General Motors Corp., Detroit, Michigan.

Before brazing immerse in a molten salt bath at 1010–1050F consisting by weight of: 15–20 per cent sodium chloride; 20–30 per cent of potassium chloride, 30–48 per cent of barium chloride, 8 to 12 per cent cyrolite and 2–10 per cent of aluminum fluoride.

4 claims.

No. 2,809,906, 10/15/57—Phosphating Compositions—H. Baecker, et al., assignors to Wyandotte Chemical Corp., Wyandotte, Michigan.

A phosphating-cleaner composition is described as consisting essentially of an alkali phosphate and an organic detergent with at least 50 per cent by weight of the detergent consisting of a conjugated polyoxypropylene-polyoxyethylene compound having the formula:

$$Y\ [(C_3H_6O)y\ (C_2H_4O)_2H]$$

6 claims.

No. 2,809,929, 10/15/57—Copper Plating Anodes—B. Ostrow and Fred Nobel, North Bellmore and Valley Stream, New York.

Several objects of this invention are: to provide an anode which has uniform corrosion, an anode which does not develop passivity and which does not form sludge.

The claims describe such an anode as containing 0.05 to 1.5 per cent of iron, nickel, or cobalt, preferably oxygen-free.

3 claims.

No. 2,810,682, 10/22/57—Silver Powder—K. Brown, assignor to Ions Exchange and Chemical Corp., New York, New York.

Silver powder can be formed on a cathode from an electrolyte of 2 to 50 per cent of hydrofluosilicic acid containing silver anodes at 0.03 to 0.5 amp/sq cm.

3 claims, figure.

No. 2,810,685, 19/22/57—Electrolytic Manganese—W. Sakowski, Youngstown, New York.

Done in a diaphragm cell containing manganous chloride and ammonium chloride.

2 claims.

No. 2,810,686, 10/22/57—Electrolytic Treatment of Waste Sulfate Pickle Liquor—G. Bodamer and C. Horner, assignors to Rohm and Haas Co., Philadelphia, Pa.

The use of a permselective diaphragm to separate anolyte and catholyte is described.

13 claims, figure.

No. 2,810,691, 10/22/57—Electroplating Conductor—M. J. Urilakas, Sacramento, California.

An electroplating current conductor, submerged below the electroplating bath, is described for carrying heavy currents to a rotating member such as a crankshaft.

4 claims, figure.

No. 2,811,426, 10/29/57—Aluminum Treatment—R. Mason, assignor to Aluminum Company of America, Pittsburgh, Pa.

Immerse aluminum parts in a bath of 0.5 to 4 per cent of sodium fluoride and 0.025 to 1 per cent of sodium aluminate in water at 150 to 212F, then treat with acid to remove the film formed. This yields a uniform matte finish.

4 claims.

No. 2,811,430, 10/29/57—Abrasive—J. Gregor and H. Van Orden, assignors to Abrasive and Metal Products Co., Detroit, Michigan.

An abrasive article comprising abrasive grains, a thermostat binder resin and a filler consisting of at least one alkali metal salt ($SO_4^=$, Cl^-, Br^-) mixed with 5 to 70 per cent of ZnS is described.

11 claims.

No. 2,811,466, 10/29/57—Chromizing—G. Samuel, assignor to Metal Diffusions, Inc., Philadelphia, Pa.

A material for chromizing ferrous surfaces is described as consisting of 35 to 90 parts by weight of a powder consisting of ferrochromium and chromium, 10 to 65 parts of inert refractory powder and between 1/100 and ¼ part of ammonium bifluoride.

3 claims.

No. 2,811,484, 10/29/57—Electrodeposition of Zinc on Magnesium—H. DeLong, assignor to Dow Chemical Co., Midland, Michigan.

Zinc can be plated on magnesium alloys containing at least 85 per cent magnesium by making the article the cathode in a bath containing an alkali pyrophosphate (pyrophosphate, 40 to 310 g/l), a zinc salt (zinc, 4.3 to 19.35 g/l), an alkali fluoride (fluoride 2.5 to 6.5 g/l) and an alkali sulfate (sulfate, 2 to 47 g/l). The bath is operated at a temperature of 70–190F and a *p*H of 10.2 to 10.8. Ammonium alginate up to 1.9 per cent is mentioned in one claim.

6 claims.

No. 2,811,490, 10/29/57—Cobalt Catalytic Screen—B. Sherwood, assignor to North American Aviation Corp., California.

Plate screen with a cobalt inert metallic sealing layer, electroplate with porous cobalt, dip in an HNO_3–$AgNO_3$–$Co(NO_3)_2$ solution, dry, plate with porous cobalt, then redip in the Co, Ag, nitrate solution and dry.

6 claims, figure.

No. 2,812,270, 11/5/57—Metal Coatings—P. Alexander, as-

(*Continued on page 171*)

Photo courtesy Adrian Rack Co., Adrian, Mich.

What coating comes up with proof of service?

Unichrome Coating 218X, of course!

FOR 10 YEARS now, Unichrome Coating 218X has been saving on rack maintenance. In fact, this non-contaminating vinyl plastisol coating has lasted as long as 6 years in daily use on one set of racks without chipping, tearing or blistering! Platers agree that *using such unmatched quality right from the start saves most money in the long run.*

Free-rinsing and extremely durable, Unichrome Coating 218X gives trouble-free service in the harshest plating and cleaning operations, even those with vapor degreasing cycles. Apply it yourself, or write us for names of nearby expert applicators.

First name in plastisols for all plating purposes...

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PLATING MATERIALS
ORGANIC COATINGS
TIN & TIN CHEMICALS
CERAMIC MATERIALS
WELDING SUPPLIES
METALS & ALLOYS
HEAVY MELTING SCRAP

METAL & THERMIT
CORPORATION

GENERAL OFFICES: RAHWAY, NEW JERSEY

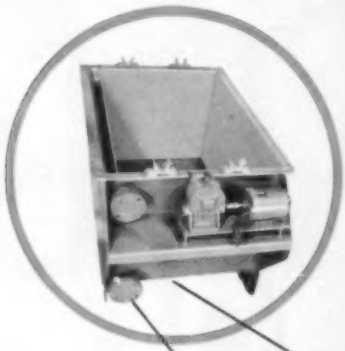
Pittsburgh • Atlanta • Detroit • E. Chicago • Los Angeles
In Canada: Metal & Thermit — United Chromium of Canada, Limited, Rexdale, Ont.

Member, Vinyl Dispersions Division of the SPI

ECONOMY—EFFICIENCY—
YOU GET ALL THREE FROM

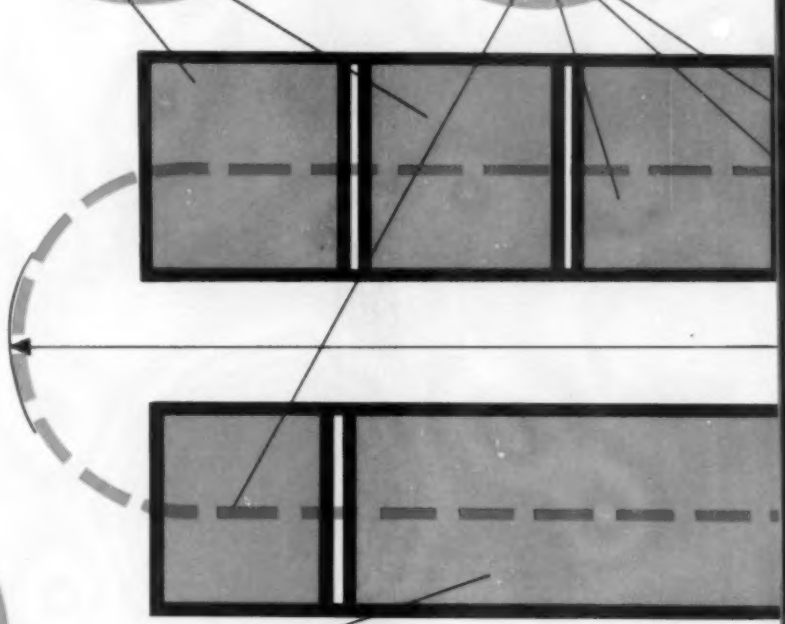
MOTORIZED TANK (KOROSEAL LINED)

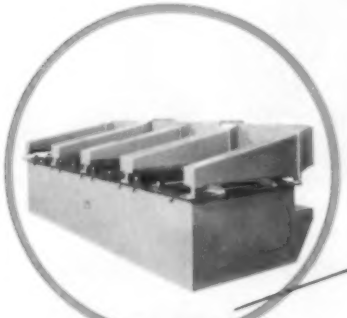
MOTORIZED TANK (NOT LINED)



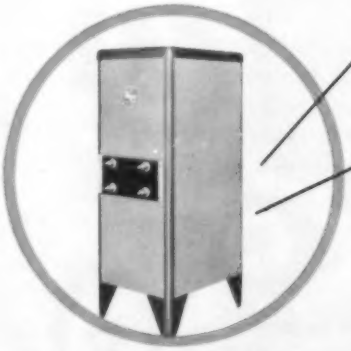
Here is a typical alkaline or acid barrel plating plant layout designed by the UDYLITE Engineering Department for fast, efficient metal finishing. This system, with the proper UDYLITE equipment placed in a practical flow chart pattern, comprises the ultimate in modern plating production.

Naturally, different plant limitations and end-products require individually planned layouts. For this reason, the UDYLITE Engineering staff and their knowledge are available to you for your particular shop needs. If a modern, money-saving plating plant is your goal...why not let UDYLITE help you plan it!





4 BARREL PLATE UNIT



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corporation

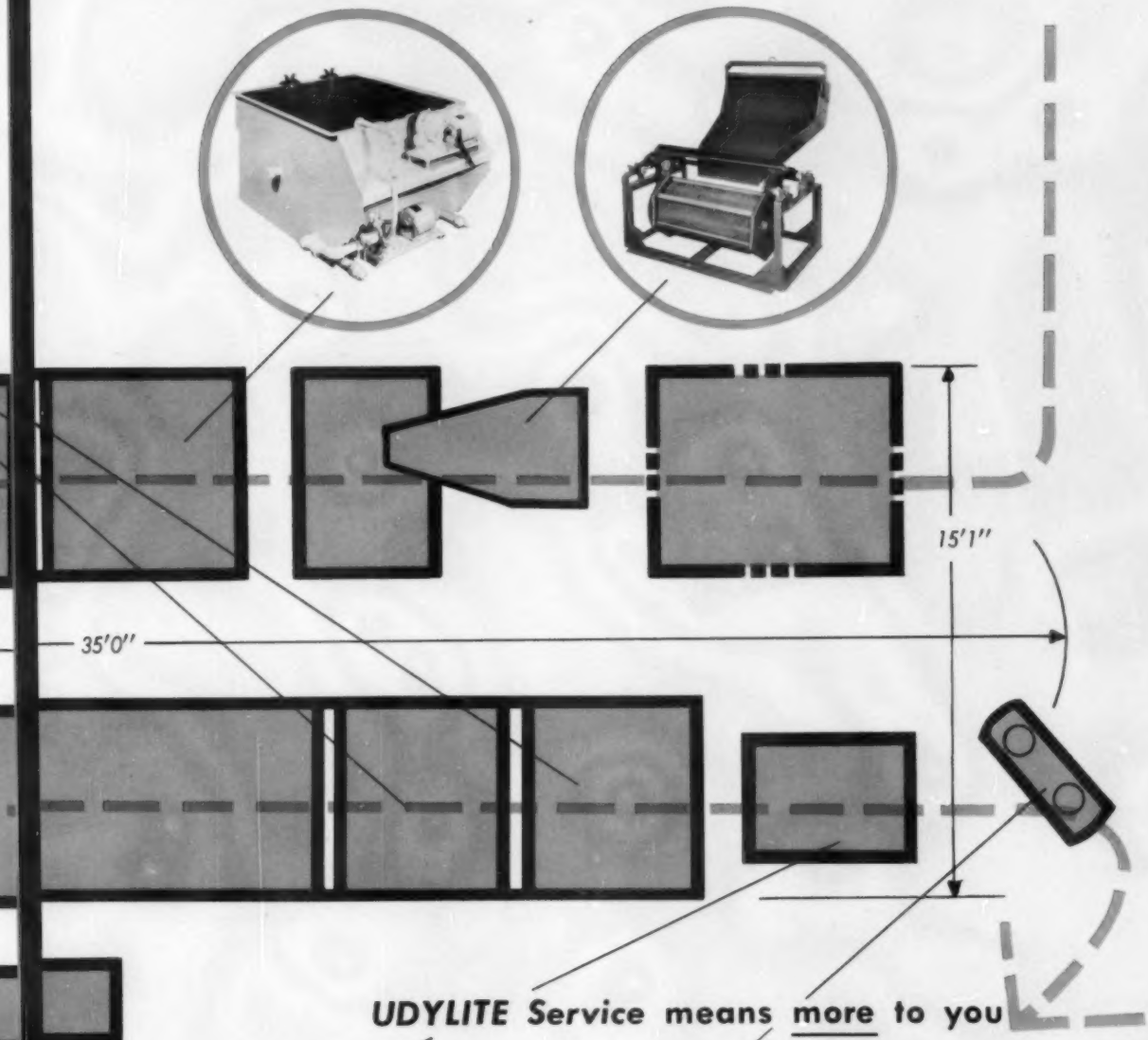
detroit 11, michigan

world's largest plating supplier

HIGH PRODUCTION
UDYLITE PLANNED LAYOUTS

MOTORIZED CLEANING TANK

LOADING STAND



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No matter what your problem, from the designing and equipping of a complete plating plant, to the *right* answer on a plating process or choice of supplies, UDYLITE is at your service! The UDYLITE Customer Service Laboratories are ready to analyze and report on your plated samples and solutions at any time. The UDYLITE Engineering Department is ready to advise and assist you with everything from suggestions to specific planning.

If you're not taking advantage of UDYLITE's many diversified services, you'd better contact your local UDYLITE representative today! For progress in plating . . . with economical equipment, processes, and technical assistance . . . UDYLITE leads the way!

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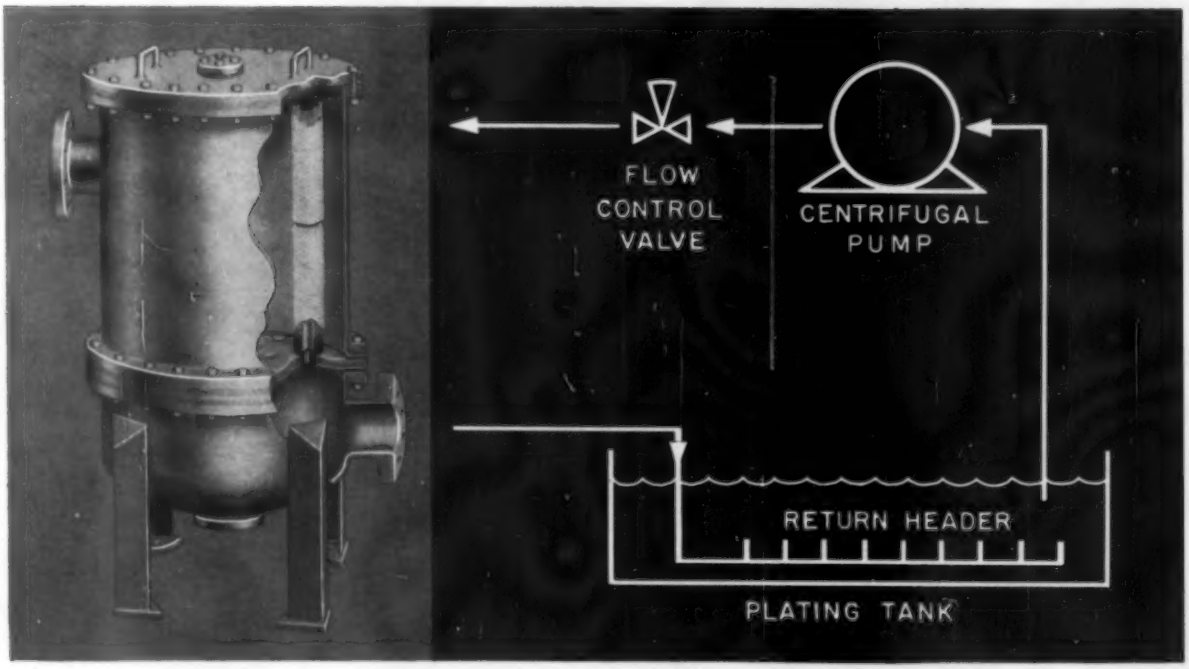

GET COMPLETE TANK TURNOVER— 3 TIMES PER HOUR–with *Fulflo Filters*

Here's a brand new concept of plating filtration! Fulflo Filters permit economical stepped-up tank turnover of two — or even three — times per hour. This means complete solution filtration up to four times in an eight-hour day!

Impurities must be removed as fast as they are formed in order to assure flawless plating. Yet even a continuous tank turnover of once per hour (an hourly flow rate equal to the amount of solution in the tank) actually provides complete filtration of the solution only once in six hours. In the past, size and cost of filters have made it impractical to achieve greater filtration rate. Now, Fulflo Filters, with exclusive Honeycomb Filter Tubes, are both compact and economical. Low-cost tubes last 6 to 12 weeks and can be renewed in a few moments. There's no maintenance cost between changes.

For a new concept in plating filtration,
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Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

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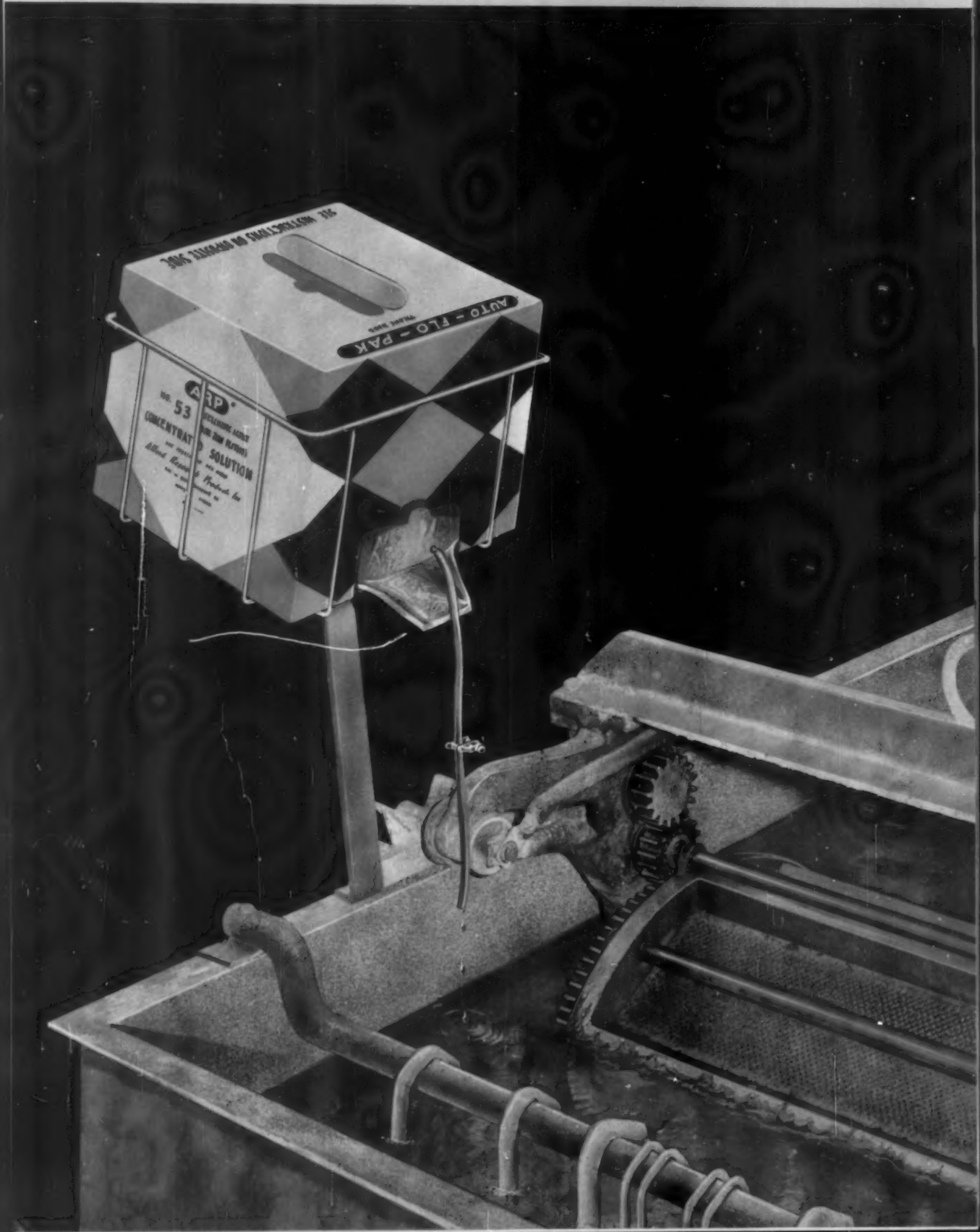


& CADMIUM PLATING *Easier with*

1—Revolutionary AUTO-FLO-PAK TRADE MARK for Liquid Brighteners

Provides accurate, steady, automatic feed for more uniform plating, lower plating costs. When used with easy-to-set-up Auto-Flo Dispenser, you get:

AUTOMATIC MAINTENANCE OF PROPER BRIGHTENER LEVEL—This amazing AUTO-FLO-PAK and new brightener dispensing method require only a single setting to assure a constant, peak-efficiency, uniform flow of brightener. There's no danger of adding too little or too much . . . no waste, no muss, no bother.

MORE UNIFORM BRIGHTNESS, MORE UNIFORM PLATE—Each part you plate gets the full effect of brightener as it is fed into the solution . . . helps produce a uniform, diamond-bright plate throughout the entire run.

The AUTO-FLO-PAK consists of a specially designed one-gallon polyethylene container in a cardboard carton. It is designed for use in conjunction with the Auto-Flo Dispenser, consisting of a wire mounting rack and feed tube. The Auto-Flo Dispenser is available from Allied. For those who prefer to pour a specified amount of liquid brightener into the plating solution, the AUTO-FLO-PAK has a handy pouring spout on the top and a measuring window on the side.

The ready-to-use AUTO-FLO-PAK, 6 to a case, is easier to handle and gives better inventory control. You can tell at a glance what you have in stock . . . and you release just the right amount to your production line. The AUTO-FLO-PAK takes up less storage space and can be easily lifted on and off shelves.

The Auto-Flo Dispenser with the adjustable feed tube assembly provides absolute and positive brightener flow control. Once you set it, you forget it . . . and you automatically and constantly get maximum brightness, efficiency and economy. There's little chance of wasting any brightener. The Auto-Flo Dispenser is easily attached to any tank . . . does not interfere with plating operations.

2—New, Low-Cost ARP® #53 Liquid Brightener

A great new Liquid Barrel Zinc Brightener that gives you:

LOWER PLATING COSTS—ARP 53 is not only low in purchase price but low in operating costs.

LONGER LIFE—ARP 53 has excellent stability at high temperatures . . . also after shut-downs of the plating bath.

DIAMOND-BRIGHT FINISH—ARP 53 gives bright plate over a wide range of current densities in barrel plating. ARP 53 maintains excellent throwing power and reaches deep recesses easily with uniformly bright deposits . . . provides ideal plated surface for clear bright or colored Iridite coatings.

EASE OF USE—Like all ARP brighteners, ARP 53 is 100% organic in nature, easy to put into use and gives immediate results.

MORE GOOD NEWS FOR ZINC AND CADMIUM PLATERS!

ARP 31 for rack zinc plating and ARP 41 for all cadmium plating are also available in the convenient new AUTO-FLO-PAK . . . at slightly higher prices to cover special packaging.

SPECIAL INTRODUCTORY OFFER!

As a special introductory offer, we'll send you one Auto-Flo Dispenser at a special price of $4.40 with your first order for ARP 53, ARP 31 or ARP 41 in the AUTO-FLO-PAK, 6 to a case. Additional Auto-Flo Dispensers are available at regular price of $8.80. This offer expires MAY 31, 1958, so clip coupon, fill out and mail today.

PLEASE SEND ME:

_____ cases of ARP 53 (9 lbs. per AUTO-FLO-PAK) @ $ .75 lb. $40.50 per case.

_____ cases of ARP 31 (10 lbs. per AUTO-FLO-PAK) @ $1.02 lb. $61.20 per case.

_____ cases of ARP 41 (8 lbs. per AUTO-FLO PAK) @ $ .64 lb. $30.72 per case.

_____ also send me Auto-Flo Dispensers at $4.40 each.

_____ I would like more information of ARP # _____ and the AUTO-FLO-PAK.

NOTE: *Special price on Auto-Flo Dispenser applies only to the first case order on each brightener.*

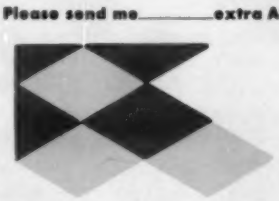
Please send me _____ extra Auto-Flo Dispensers at $8.80 each.

COMPANY _____

STREET _____

CITY _____ **ZONE** _____ **STATE** _____

Order Authorized by _____



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ASME Names New Fellows

Thirteen Members of The American Society of Mechanical Engineers have been transferred from that rank to Fellow of the Society, an honor reserved for less than one per cent of the organization's 50,000 members.

The new Fellows, according to an announcement by ASME, are: Richard G. Folsom, professor of mechanical engineering at the University of Michigan; Albert N. Horne, vice president and general manager of the Texaco-Cities Service Pipe Line Company; Jerome J. Kanter, director of engineering research and development at the Crane Company of Chicago; Myron A. Kendall, chairman of the Board of Directors of the Stephens-Adamson Manufacturing Company, Aurora, Illinois; Harold E. Martin, president of the Metal and Thermit Corporation; Harold B. Maynard, president of the Methods Engineering Council; Gordon R. Milne, chief mechanical engineer for the Consolidated Edison Company of New York; Arthur H. Morey, supervisor of advance engineering for the General Electric Company of Erie, Pennsylvania; Arthur M. Perrin, president of the National Conveyors Company in Fairview, New Jersey; George A. Porter, vice president in charge of engineering, construction and operations for the Detroit Edison Company; J. Kenneth Salisbury, consulting engineer; Harold S. Sizer, director of design for machine tools for Brown and Sharpe Manufacturing Company of Providence, Rhode Island; and Ronald B. Smith, operating vice president of the M. W. Kellogg Company, New York City.

Sea Horse Institute Meets in June

The spring meeting of the Sea Horse Institute will be held at Harbor Island, North Carolina June 2 to 5 inclusive. The meetings will cover cathodic protection, metals, coatings and other topics submitted by February 1.

Corrosion Problems Covered in NACE Papers

Ten papers will be given during the General Corrosion Symposium at San Francisco during the 14th Annual Conference and Exhibition of the National Association of Corrosion Engineers, March 17–21, 1958. Most of the technical meetings will be at the Civic Auditorium, San Francisco. Fifteen other symposia are planned on such subjects as cathodic protection, coatings, plastics, oil and gas production, marine exposures, pulp and paper industry, utility industry, pipelines and high purity water.

Four round table discussion sessions will be held on refinery industry problems, utility cathodic protection system coordination, general corrosion problems and pipeline and underground corrosion.

Behavior of new corrosion resistant nonferrous metals in chemical industry applications will be featured during the Chemical Industry Symposium at the 14th Annual Conference and Exhibition of the National Association of Corrosion Engineers. The conference will be held March 17–21, with most meetings and the exhibition held at the Civic Auditorium, San Francisco. The symposium will have 12 papers in three sessions.

Among the materials discussed will be zirconium, titanium, columbium, tungsten and molybdenum. One paper deals with the resistance of materials to concentrated hydrogen peroxide, such as that used in missile rocket engines. Corrosion problems involved in uranium refining, characteristics of lead acid-brick construction and some of the problems encountered in reactors using high purity water and sodium as coolants also will be discussed.

Reactions of structural materials in nitric, hydrofluoric, hydrochloric, sulfuric and other severely corrosive environments are considered in other papers.

Among the more than 80 technical committee meetings to be held during the week are many interesting to engineers in the chemical industry.

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(Continued from page 170)

signor to Continental Can Co., New York.

A method of coating metallic articles using metal vapor in an evacuated system is described.

24 claims, figure.

No. 2,812,272, 11/5/57—Method of Metallizing Articles—H. Nack, et al., assignors to Commonwealth Engineering Co., Dayton, Ohio.

Apparatus and method for plating metals on insulating in continuous lengths are claimed. A heat decomposable plating gas is used.

17 claims.

No. 2,812,294, 11/5/57—Manufacture of Hollowed Articles—G. Rosenqvist, Calumet, Michigan.

In electroforming tubing (copper) the application of a tool to work the cathode surface as it is plated is described.

5 claims, figure.

No. 2,812,295, 11/5/57—Finishing Metal Surfaces—J. Patrick, assignor to General Motors Corp., Detroit, Mich.

Multi-colored designs can be made on a sheet of anodizable metal by forming a pattern having sharply defined raised portions and depressed portions, anodizing and dyeing. Apply a viscous substance(oil, wax, printer's ink) over the raised portions, then immerse in a darker dye. Remove viscous substance and seal the dyes.

2 claims, 2 figures.

No. 2,812,296, 11/5/57—Coating Steel Surfaces—R. Neish, assignor to U.S. Steel Corp., New Jersey.

Immerse the steel article in a solution containing 1 to 6 per cent of a water-soluble chromate and 1.0 to 8.4 per cent of orthophosphate ion. Make the steel the cathode at 15 to 90 asf. In the disclosure the objects of the invention given are to increase corrosion resistance and lacquer adherence.

9 claims, 2 figures.

No. 2,812,297, 11/5/57—Preventing Etching by Chromium Plating Baths—J. Stareck and R. Dow, assignors to Metal and Thermit Corp., New York, N. Y.

To prevent etching of areas of articles not to be chromium plated caused by baths having fluoride containing catalyst, treat said areas by making the object the cathode in a bath containing 100 to 1000 g/l of CrO_3 for 0.5 to 10 min at 50 to 110F at a current density of 0.05 to 2 asf. Another claim mentions phosphoric acid also.

11 claims.

No. 2,812,298, 11/5/57—Protective Coating—R. Hardoen, assignor to Hohman Plating and Manufacturing Inc., Dayton, Ohio.

A protective coating for ferrous parts can be laid down by plating a flash zinc coating on the part after which the part is made the cathode in a solution containing 13 oz/gal of manganese sulfate, 10 oz/gal of ammonium sulfate, 8 oz/gal of ammonium sulfate, 8 oz/gal of ammonium sulfocyanate and 5 oz/gal of ammonium molybdate. The current density is given at 5 to 17 asf.

4 claims.

No. 2,812,299, 11/5/57—Deposition of Gold—F. Volk, assignor to Birle and Co., Pforzheim, Germany.

To an alkali-cyanide gold bath add a buffer to maintain the *p*H between 6.5 and 7.5. Claim 2 describes the buffer as being alkali metal, alkaline earth or ammonium primary phosphates.

16 claims.

No. 2,813,044, 11/12/57—Galvanizing Flux—A. Chester, assignor to Poor and Co., Chicago, Illinois.

A flux for use prior to hot zinc galvanizing is described as containing chromium aldonate (or gluconate) which may be dispersed in a film-forming oxyalkyated fatty amine.

18 claims.

No. 2,813,064, 11/12/57—Isotopic Fractionation of Uranium—A. Clark, assignor to the United States (AEC).

Uranous ions are concentrated on the cathode from uranyl-uranous electrolytes by electrolyzing in a counter-flow apparatus.

19 claims, figure.

No. 2,813,065, 11/12/57—Antimony Plating—A. H. DuRose, assignor to The Harshaw Chemical Co., Cleveland, Ohio.

An antimony deposit of enhanced brightness can be obtained by electrolyzing a bath containing antimony in the form of a soluble fluoride along with an aromatic sulfonamide and a heterocyclic nitrogen containing compound (pyridine, dipyridil, 2,6 dimethyl quinoline, etc.)

27 claims.

No. 2,813,066, 11/12/57—Cyanide Copper Plating—B. Ostrow, N. Bellmore, New York.

The addition of small amounts of an unsubstituted alkylpolyamine (2 to 6 amino groups and the alkyl groups having 1 to 3 carbon atoms) is useful in eliminating deleterious effect of zinc, chromium, and nickel in copper plating baths.

5 claims.

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The one bath especially designed for plating DIRECTLY on ZINC, LEAD, ALUMINUM, BRASS, COPPER and IRON.

for HARD CHROMIUM

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INDUSTRY NEWS

Charles W. Engelhard, right, board chairman of the newly formed Engelhard Industries, Inc., and Gordan V. Richdale, president of the new company, shown inspecting a divisional breakdown of the corporation.

Engelhard Industries Formed—Engelhard Industries, Inc., has been formed by a consolidation of nine American companies in the precious metals and precision-manufacturing fields, some of them over 50 years old. Three other domestic companies and twelve foreign corporations also are controlled by the same interests.

Charles W. Engelhard, New Jersey industrialist, describes the corporation as a "large, highly skilled, highly diversified industrial entity which serves, directly or indirectly, every major industy in the United States."

Charles W. Engelhard, best known heretofore as a spokesman for the world-wide platinum industry, is chairman of the board of the new company. The president is Gordon V. Richdale, a financial associate of Mr. Engelhard, a former official of the Bank of England and a former South African gold-mining executive. The two men also are chairman and a director respectively of Rand American Investments, Ltd., which controls a $400-million mining and manufacturing empire in South Africa.

The consolidation was announced at a luncheon at the Waldorf-Astoria described by a company spokesman as the largest and most elaborate affair of its kind ever held in New York by a company which does not make consumer products. Including an hour-long live show on the company's activities and an industrial exhibition of its products, it was estimated to have cost $50,000. Bars of precious metal, jewelry, and precision equipment in the exhibition were valued at $890,000.

Largest of the firms consolidated into Engelhard Industries, Inc., is Baker & Co., Inc., which grossed some $53-million last year. Its main business has been the refining and fabrication of platinum. Another is the 50-year-old Hanovia Chemical & Mfg. Co., producers of liquid precious metals for the ceramics industry and of gas-discharge lamps.

The other consolidated companies are: The American Platinum Works, refiners and workers of silver; Amersil Co., manufacturers of fused quartz; East Newark Industrial Center, Inc., managers of some 1-million sq ft of industrial property; Irvington Smelting & Refining Works; D. E. Makepeace Co., producers of atomic-reactor components and precious-metal materials; National Electric Instrument Co., manufacturers of industrial and medical instruments; and The H. A. Wilson Co., producers of thermostatic materials, electrical contacts, laminated metals, and special alloys.

Described as "associated domestic companies" were Azoplate Corp., manufacturers of lithographic plates; Charles Engelhard, Inc., designers and producers of precision equipment for industry and the armed forces; and Nuclear Corp. of America, consultants on peace-time uses of atomic energy and manufacturers of nuclear equipment.

In a brief talk on the company's future, Mr. Richdale announced that Engelhard is building a new $1-million research laboratory in Newark, and has just completed a $1-million plant at Plainville, Mass., for the manufacture of atomic-reactor components. He added that the corporation recently received the first license issued by the U. S. Atomic Energy Commission for the reprocessing of cold enriched uranium.

Peninsular Buys Nankervis—Peninsular Metal Products Corp. of Ferndale announced they had entered into an agreement to acquire all of the outstanding stock of the George L. Nankervis Co. of Detroit, prominent supplier and engineers of metal finishing equipment.

S. W. Sorensen Jr., president of Peninsular said the Nankervis Co., when acquired, would be operated as a wholly owned but independent subsidiary of Peninsular. Mr. Sorensen said the personnel and policies of the Nankervis Company will not be affected by the change of ownership.

The Nankervis Company, in addition to its metal finishing activities, also designs and builds precision testing equipment for the automotive and aircraft industries. George L. Nankervis, founder of the company, died early last year. The majority of the stock in the company was owned by him.

Pennsalt to Represent Processing Machines—Pennsalt Chemicals Corp. of Philadelphia is now exclusive sales representative for the line of metal processing machinery made by the White-Roth Machine Corp. of Lorain, Ohio.

The move brings together a chemical firm with an established line of lubricants, coatings, phosphatizing compounds and metal cleaners and strippers, and a machine company that has stressed automation in its metal processing equipment, which includes washers, coaters and driers.

The coordinated effort is being headed by John W. Mordica, veteran of over 25 years in metal processing. His headquarters will be in Lorain, Ohio.

AT LAST A BOILER DESIGNED FOR THE PLATER!

Model 105 Sellers Closed Combustion Chamber Boiler

NOW—No more foul fumes because of incomplete combustion due to back draft through boiler created by exhaust fans or poor draft conditions.

SELLERS solves this problem with the improved design, closed combustion chamber boiler. All air for combustion, both primary and secondary, is pushed through the boiler under positive pressure, independent of partial vacuum in the building and independent of any back draft on the chimney (of course, products of combustion must be removed from building).

A positive pressure blower supplies air under pressure which is mixed with the gas and passed to burners in the completely closed combustion chamber; to complete combustion, secondary air is fed into the closed chamber under positive pressure (many times greater than the vacuum in the building). By this method of securing positive complete combustion, burned gases are pushed through the boiler and FOUL FUMES ARE ELIMINATED.

Read about these Extra Features in Catalog 5206

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4. WORKS ON LOW GAS PRESSURE
5. POSITIVE PRESSURE BLOWER OVERCOMES BUILDING VACUUM AND CHIMNEY BACK DRAFT
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Ahco Liquid Buffing Compounds are made with the same high-grade abrasives as Ahco bar compounds, but with an emulsion-type liquid binder. These versatile compounds may be applied in several ways: the work or the buff may be sprayed, or the work may be dipped or brushed before buffing. The amount of compound applied to a wheel or buff can be more easily controlled; buffs run cooler — thus eliminating a fire hazard and lengthening buff life. Work surfaces clean more easily; there are no nubbins left over, so you save compound. AHCO Liquid Compounds are especially suitable for automatic buffing

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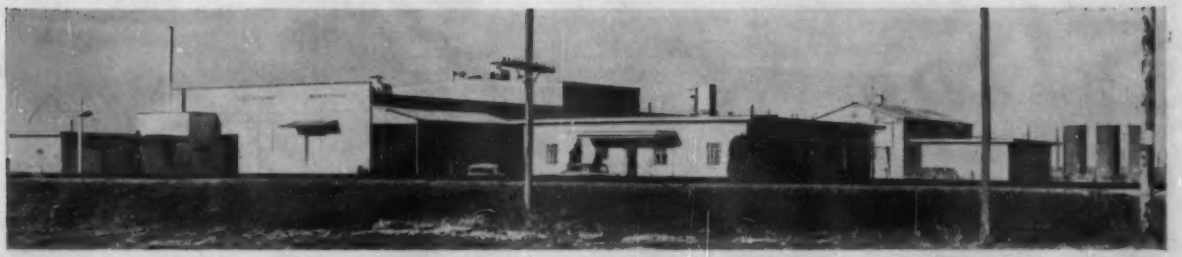

Diversey Purchases Plant—The Diversey Corp. of Chicago, manufacturer of chemical products and detergents, has purchased a five-building plant in Waco, Texas.

The new property, includes two warehouses, an insecticide plant, employes' locker rooms and an air-conditioned office building. The manufacturing room is 256 by 80 ft, with an 18-ft ceiling. Three 12,000-gal chemical storage tanks are located in the rear of the plant. The tract is located one-half mile south of the Waco city limits.

Oakite's Walter C. Sweet, left, receiving award from John A. Carter.

Oakite Award Conferred—Walter C. Sweet, Oakite technical service representative in Minneapolis since 1946, has received the 1957 D. C. Ball Award for distinguished Oakite service.

The award, named in honor of the founder of Oakite Products, Inc., manufacturers of industrial cleaning and related compounds, is given annually to the Oakite representative who "best carries forward with his customers the highest ideals of Oakite service".

Mr. Sweet, who was selected from the company's 227-man field organization, received the award from John A. Carter, president, at Oakite's recent sales conference in Chicago.

Heatbath Appoints Representative—Heatbath Corp. has appointed International Chemical and Metallurgical Supply Corp. of Fort Lauderdale, Florida as their exclusive sales representative in Florida and Latin America for the sale of its complete line of heat treating and metal finishing products. Laboratory facilities and technical service will be made available through International, for customers in that area.

Stackpole Carbon's Facilities Redesigned—According to an announcement by Dr. A. K. Graham, president of Graham, Savage and Associates, Inc., the Stackpole Carbon Co., of St. Marys, Pa. has engaged his firm to design plating and waste treatment facilities for their plant. The plan is to gather existing scattered plating operations into one area to provide

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Two-Spindle Variable Speed Lathe

STEP UP PRODUCTION—REDUCE FINISHING COSTS with Hammond DOUBLE SPINDLE LATHES

- No "down time" for one operator when the other changes wheel — each operator has his own motor, control and variable speed drive.
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- Available in 3 sizes — two 5 HP, two 7½ HP or two 10 HP.

ALSO AVAILABLE IN WIDE SWING MODEL VRROW

Wide swing construction, with extended bearing housings and spindles, provides additional working space for large, bulky pieces.

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Sel-Rex Corporation's Open House at their new Nutley, New Jersey plant on December 13. Morris M. Messing, left, Sel-Rex president, receives visit in his office from A. G. Wentworth, former president of Seymour Manufacturing Company. The picture at right shows a few of the guests approaching the sumptuous buffet.

a modern plating department with room for expansion.

The floor will be pitched and trenched to provide segregation into cyanide, chromate and other wastes for proper treatment. There is a fairly large silver plating installation, and provision has been made to recover silver from rinse waters and floor drainage.

Metal Finishers Builds Plant—Metal Finishers, Inc., Cleveland, Ohio, announces the construction of a new plant at 3125 Brinkerhoff Road, Kansas City, Kansas.

The new facilities will chromium plate cylinder liners for the railroad, pipeline, refinery and river boat industries.

The building will be a one story masonry structure of 25,000 square feet situated on approximately 2½ acres of land and will include railroad siding facilities. It will be in operation early this year.

The plant will have a capacity of 60,000 amp of plating current and will utilize the latest germanium saturable reactor core rectifiers with magnetic amplifiers.

Schori Installs Exhausts—Schori Process Division has installed six Iolyte fume exhausts in the electroplating department of Curtiss-Wright Corporation, Wood-Ridge, N. J. These ducts carry off fumes from preparatory plating processes involving caustics, sulfuric acid and cyanide, and fumes from the plating of cadmium, copper and bronze parts. Fifty-five ft long and approximately 3 ft in diameter, each duct was fabricated in 7 sections; joints for assembly were made at the plant.

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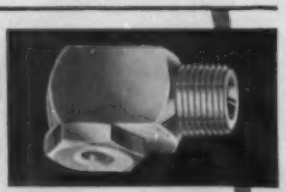
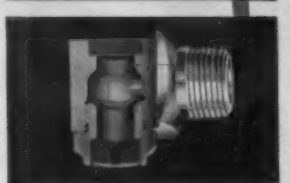


materials

brass, stainless steel, lead, hard rubber, hardened steel, tungsten carbide and many others.



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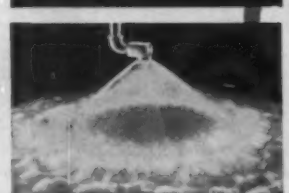

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Comprehensive manual of 102 pages containing precautions to be observed in collecting samples of metal finishing wastes, fundamentals of sampling techniques, the determination of cyanide, cyanate, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc, ammonia, chloride, chlorine, nitrate-nitrite nitrogen, ortho-phosphate, and sulfate—and a section on pH and residue.

This valuable publication, developed from American Electroplaters' Society Research Project at Lehigh University and expanded and prepared by the Metal Finishing Industry Action Committee of the Ohio River Valley Sanitation Commission is available at

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INDUSTRY NEWS BRIEFS

SYLVANIA PROCESS PLATES COPPER ON ALUMINUM STRIP/WIRE

Development of a process for electroplating copper on aluminum strip and aluminum wire has been announced by Sylvania Electric Products Inc., Warren, Pa.

Richard E. Corcoran, product sales manager-wire and weld of Sylvania's Parts Division, said that the new technique permits plating of aluminum strip in widths up to 10-in. and in thicknesses from .008 to .050-in. Thickness of the copper plating ranges from a flash coating to .002-in. per side.

Mr. Corcoran said that aluminum plated by the new process can be tinned, soldered or formed without breaking the copper plating which exhibits excellent adhesion characteristics.

"Copper-plated aluminum can be used in printed circuitry, bus-bar type conductors and numerous other electrical-electronic applications," Mr. Corcoran added.

LEA-MICHIGAN BUYS INDUSTRIAL LUBRICANTS

As of January 2, 1958, Lea-Michigan, Inc., subsidiary of The Lea Mfg. Co., purchased all of the inventory, good will and trademarks of the Industrial Lubricants Co., Inc., and plans to continue the manufacture and sales of Grainlock cements and Drawco drawing compounds under the name, Industrial Lubricants Div., Lea-Michigan, Inc.

Lea-Michigan soon will move its entire office from its present quarters on Stansbury Ave., Detroit to 14459 Wildemere, Detroit, but will continue to operate both manufacturing plants until further notice. Industrial Lubricants Div. of Lea-Michigan will continue to offer the Industrial products to its trade and contemplates no changes in the presently existing sales and distribution arrangements. In addition, there will be no change in personnel in the Industrial Lubricants Div.

NICKEL PRODUCTION TO REACH PEAK IN 1961

Based on continued comparatively low defense requirements for nickel, full stockpile deferments and a new high in availability of total supply, the amount of nickel remaining for civilian use in the United States in 1958 will be the largest ever, Lars R. Larson, vice president and general sales manager of the International Nickel Co., Inc., said on Jan. 13.

"Large defense and stockpile requirements in the U. S. were responsible for the nickel shortage," Mr. Larson said. "A few years ago the free world took close to 40 per cent of available nickel for defense and stockpile needs. In 1957 it took 20 per cent. The sharp downtrend in defense which started in mid-1957 continues and is now at a new low. Government stockpile plans have also changed drastically. The 117,000,000 lb diverted in 1957 are a large part of the answer to the increase in civilian nickel supplies. The total 1957 supply of 305,000,000 lb to the United States was the largest that has ever been available in the history of the nickel business.

"In 1961, just a little over three years from now, according to present plans, practically all of the new planned production will be available. As projected now, the free world will have available at that time between 650,000,000 and 675,000,000 lb of nickel annually."

INCREASED DEMAND FOR COPPER SEEN IN 1958 THIRD QUARTER

Current trends in the durable goods and construction industries, as well as indicated decline in planned expenditures for capital expansion in most industries, point to probable leveling off in the demand for copper base products in the first half of 1958, the Business and Defense Services Administration has reported.

The copper division, looking at 1958, said, however, that there are good prospects for an upturn in demand starting in the third quarter.

Barrel Nickel Plating

●

With nickel no longer short it is now necessary to return to quality operations. This requires more care with the solutions. Actually the most important single ingredient is boric acid. It is also the cheapest ingredient. Low boric acid causes burning, brittleness and increases the effect of impurities. The chloride content can be maintained to secure good anode corrosion. And now is the time to consider the economics of magnesium chloride rather than nickel chloride. It merits consideration both from actual cost and from high purity eliminating dummy plating.

●

Dummy plating is the only way of removing the copper and zinc which so often contaminate nickel plating solutions. The contamination most often appears as a result of heavy additions chiefly nickel chloride.

●

Proper dummy plating is done by using a voltage of ½ to ¾ usually best secured from a separate low voltage rectifier. The average barrel will draw less than 20 amperes under these conditions and complete removal of copper may require up to 48 hours of dummy plating not necessarily consecutive.

●

With modern barrels don't settle for less than the best formulas and addition agents. True Brite has pioneered modern barrel nickel plating. We like to think that our customers are doing work they are proud of and their letters indicate this. Of course they have trouble but with our simple system they don't have trouble long. And we're back of all of them with more know-how than anyone else can claim. If you have really used our products you'll know what we mean.

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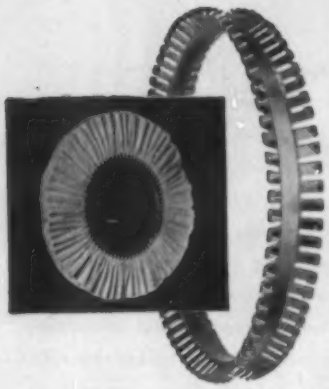

E—200. Clinch Rings—Newly developed controls in the manufacturing process now enable American Buff Co. to produce clinch rings with gripping power never before possible, the company has announced. Company engineers are said to have perfected a projection welding procedure with important advantages over previous spot welding techniques. This development increases the uniformity of all types of buffs made by them. An improved method of die-forming clinch-ring teeth is also used to produce teeth 25 per cent larger than heretofore. These two new features are claimed to triple the strength of the rings and provide such a secure grip that both bias type and unit type buffs can be manufactured of heavier fabrics than ever.

E—201. Dust Collector—A new 53 in. high junior cyclone Duskolector has been developed by Hammond Machinery Builders, Inc. It is available in two capacities, 400 cfm and 600 cfm, and employs centrifugal precipitation and gravitation for the removal of larger particles. The latter are deposited in the removable receptacle in the base. Smaller particles are exhausted outdoors or trapped in a bag attached to the outlet. Bag is easily removed and

equipped with a zipper for quick cleaning. With the bag style, the air is recirculated and heat is thus saved.

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Regular use of Zinc-Brite, keeps solutions CONSTANTLY clear.

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The use of Zinc-Brite eliminates the need for any other purifying treatment. It brightens work.

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A 3M Case History Report

STEEL POLISHING SPEEDED 10–15% WITH "PG" WHEELS

MANUFACTURER: Heintz Division of Kelsey-Hayes Co.

ADDRESS: Philadelphia, Pennsylvania.

PRODUCT MANUFACTURED: Automotive Metal Stampings.

3M ABRASIVE USED: "PG" Wheels.

HOW 3M ABRASIVES ARE USED: Finishing operation. Remove die marks, scratches, and other forming defects from cold-rolled carbon steel auto grille bars, prior to plating.

OPERATIONAL DATA ON 3M METHOD: Grit 220 Resin Bond Cloth "PG" Wheel on double-spindle floor lathe with buff-wheel.

OPERATIONAL DATA ON PREVIOUS METHOD: 2-station, 3-step method. 1st, #120 disc; 2nd, set-up wheel; 3rd, buff-wheel.

PROVEN ADVANTAGES OF 3M METHOD: Former 3-step operation reduced to 2 steps; "PG" Wheel and Buff. "PG" Wheel leaves no scratches on work piece; speeds production 10-15%.

OTHER 3M ABRASIVE PRODUCTS IN USE: "Three-M-ite" Resin Bond Cloth Portable "PG" Wheels on hand-grinders are used to remove in-use scratches, other imperfections from dies, without removing them from press. "PG" Wheels replaced hand methods, reduced repair time from 14 hours to 30 minutes.

WANT MORE INFORMATION? Send for free manual, "Modern Metal Finishing with 3M 'PG' Wheels." Write to 3M Co., St. Paul 6, Minn., Dept. MR-28.

"PG" Wheels are manufactured in U.S.A. by 3M Company, St. Paul 6, Minn. Export: 99 Park Avenue, New York. Canada: London, Ontario

3M Coated Abrasives

"PG" WHEELS

MINNESOTA MINING AND MANUFACTURING COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

E—202. Anode Container—Hang-up of anodes is said to be eliminated through use of a new type anode container, developed recently by Wagner Brothers Inc.

Of welded construction, the container is of the basket type with its vertical members and supporting rings arranged to provide maximum weight distribution in supporting the heavy metal anode loads.

Other features include double spacing of vertical members at the lower portion of the unit, and reinforced bottom, both by an extra heavy steel ring, and an angle type spine which bends under the bottom, and runs the full length of the container to end up as a hook at the top.

E—203. High Voltage Selenium Rectifiers—Substantial savings in size and cost of rectifier assemblies for magnetic amplifier, high voltage industrial battery charger and all military power supply applications, are claimed to be made possible by the introduction of high voltage selenium rectifier cells featuring rms inverse voltage ratings of 45 and 52 volts per cell—now available from International Rectifier Corp.

This 73 to 100 per cent increase in voltage over the standard 26 volt cell offers a distinct size advantage, since only half the number of 52 volt cells are required per stack, thus reducing the volume of the stack by 50 per cent. These cells are said to have approximately one-half the leakage current at 52 volts that standard cells are permitted at 26 volts.

The current density rating of the high voltage cells is essentially equivalent to the NEMA standards: 160 ma/sq in., half-wave, resistive load. Forward voltage drop is comparable to that of standard cells. Now available in plate sizes from 1 by 1 in. to 4 by 4 in., these rectifiers have passed the military environmental and life tests as specified under MIL-R-11050A.

E—204. Electro-Analyzer—The latest electronic refinements are said to have been used to make Fisher Scientific Co.'s new Model 40 controlled-potential electro-analyzer an improvement over its predecessor.

It has a completely new electronic control system. A special "chopper" circuit makes it possible to use an AC amplifier.

With a new voltage selector, the operator can plate out major components quickly, using a high current. He can change the transformer ratio, giving closer control of the cathode potential when he analyzes for trace metals.

Model 40 has two independently controlled stations, so that two analyses, for the same or different metals, can be run at the same time. Both stations are standardized simultaneously, with the same control.

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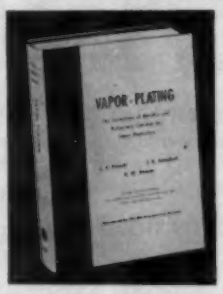
The Formation of Metallic and Refractory Coatings by Vapor Deposition



By C. F. POWELL, I. E. CAMPBELL, and B. W. GONSER, all at the Battelle Memorial Institute.

1955. 158 pages. Illus.

$5.50.

AES Members $4.60

This is the first single source of reference for data and information on these processes. Provides a critical and authoritative review of the applications and techniques of vapor deposition of metals and non-metals.

The versatility of vapor-plating processes is stressed by the authors in an effort to stimulate the use of these processes as a flexible tool in many fields of technology. Sponsored by THE ELECTROCHEMICAL SOCIETY.

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E—205. Addition Agent—Smooth surface copper plating to any thickness is claimed for CuSol, a new addition agent developed by The Seymour Manufacturing Co., for acid copper bath solutions.

The process is said to eliminate roughness, treeing and nodular build-up, making it particularly useful for electroformed molding operations. Since its acid base does not affect the laminate boards, it can also be used for printed circuit manufacture.

A .030-in. CuSol copper plate has the same ductility and elongation as .016-in. plating accomplished through ordinary acid copper solutions, according to the company. Current density range is from 5 to 280 asf.

E—206. Cleaners—Allied Research Products, Inc. has announced the introduction of a new line of cleaners formulated to prepare zinc die castings and aluminum for coatings. All are designed to give long bath life and maximum cleaning efficiency. Each cleaner is supplied in powdered form and is completely water soluble. Each contains water-conditioning, anti-foaming and anti-caking agents for good rinsability and ease of use.

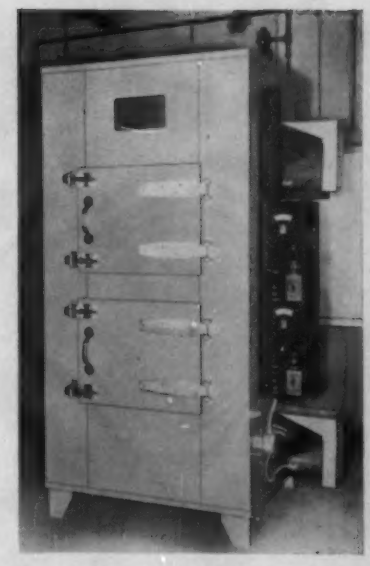
They include a zinc die cast cleaner, aluminum etch cleaner, non-etch aluminum cleaner and an aluminum deoxidizer.

E—207. Simultaneous Plating Solutions—New plating solutions have been developed by Dalic Metachemical Ltd. to allow tin and lead to be plated singly, or in combination, in any proportion of value. High-lead-content alloys (93 per cent) are suitable for bearing applications and 60–40 tin-lead alloys for components requiring subsequent soldering. These and any intermediate percentages for special purposes are achieved by mixing the solutions in proper volumetric proportions.

Both the plating solutions are slightly alkaline, the tin having a *p*H of about 7.5, the lead ranging between 8.0 and 8.5.

E—208. Two-Chamber Oven—A new type of oven used for relief of hydrogen embrittlement on plated parts and stress relieving and normalizing of tools, springs, etc. has been introduced by Grieve-Hendry Co., Inc. The oven has two chambers, each operating independently and having individual maximum operating temperatures. Electric heating is employed. It can be had with either electric or gas heating equipment.

The upper chamber has a 15 kw heat input capacity, with a maximum operating temperature of 1000F. It also has a 720 cfm stainless steel interior and recirculating



blower. Bottom of work space is 50 in. from floor. The lower chamber has a 6 kw heat input capacity with a maximum operating temperature of 650F. This chamber has a 400 cfm recirculating blower. Bottom work space is 25 in. from floor.

Common to both chambers is a work space 24 by 24 by 18 in. high—single doors—one control panel—individual indicating and excess temperature controls.

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provides many successive filtrations in ONE operation—clear and continuous through multi-layered SETHCO filter tubes. Removes all coarse and fine particles down to one micron. Fast, effective filtration and recovery of all electroplating and industrial solutions—hot, cold, alkaline or acid from pH 0 to pH 14. Compact, portable—simple operation and care . . . at low cost.

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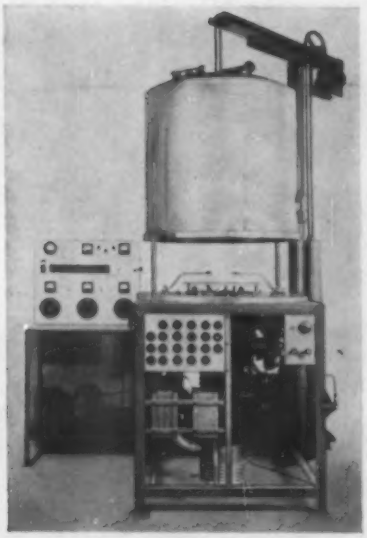

E—209. Vacuum Evaporator—A new production-size Kinney high vacuum evaporator designed for precisely-controlled deposition of evaporated coatings has been announced by the Vacuum Equipment Division of The New York Air Brake Co. Designated the P-5, this evaporator can be used for all types of vacuum coatings, such as: silver, gold, aluminum, magnesium, chromium, etc., according to the manufacturer.

It has a stainless steel vacuum tank 36 in. in diameter by 42 in. in height and an electrically operated rotatable hoist for lifting the bell jar to afford convenient access to the work area. The pumping system is claimed to reach a pressure of 1×10^{-4} mm hg in seven minutes and attain ultimate pressure of 1×10^{-6} mm hg.

E—210. Immersible Motor—The Louis Allis Co. recently announced a new immersible motor for submerged operation. The unit is designed for close-coupling to agitators or pumps.

In pump applications this flange-mounted motor is claimed to eliminate many connecting components, since the motor shaft is directly attached to the impeller. Motor and pump can be raised and lowered into position together by means of the motor's lifting lugs.

Features include neoprene breathers, oil-filled at factory, waterproof cable connection, and corrosion resistant parts.

E—211. Silicon Power Rectifiers—International Rectifier Corp. announces the availability of silicon power rectifiers designed to meet the rigid requirements of MIL-E-1 and MIL-T-195CO-A. The IN412B is rated at 35 amp rectified dc output current with a PIV rating of 100 volts. Also available are the IN411B and the 1N413B rated at 35 amp with PIV voltage ratings of 50 and 200 volts respectively.

E—212. Sodium-Copper Cyanide Salt—Sodium-copper cyanide double salt for use in copper plating solutions formulated with sodium cyanide has been established as a regular product by DuPont's Electrochemicals Department.

Use of this salt is claimed to facilitate the make-up or replenishment of plating solutions by eliminating the several steps required to dissolve copper cyanide properly.

E—213. Etching Process—A new process for etching printed circuits, which employs as the etchant an aqueous solution of ammonium persulfate has been developed by Becco Chemical Division, Food Machinery and Chemical Corp.

The procedure can be used for all conventional boards and laminates and will not attack conventional resists. It can be used for the etching of plain copper circuits and circuits plated with gold, rhodium, or other metals—and for etching solder-plated circuits, which ordinarily require chromic acid etching.

The process can be carried out in conventional etching equipment, using tank immersion or spray techniques. It does not require ventilating equipment, because neither fumes nor spray are developed during operation of the bath.

E—214. Chemical Blanket—A chemical blanket, Serseal, has been developed by the American Chemical Paint Co. for use on hot phosphate coating baths.

It acts as a barrier to prevent the escape of steam and fumes. Heat savings up to 70 per cent have been claimed. It is also said to have shown great reductions in the cost and time required for maintenance of heating elements. Since the bath is sealed, there is little escape of fumes and vapors.

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As a reference source to help Branches and Branch officers in effective Branch operation, many dedicated National and Branch leaders collaborated, without any remuneration, in preparing the comprehensive BRANCH OFFICERS MANUAL of the American Electroplaters' Society, embodying practically every conceivable Branch operating subject from membership promotion to Delegates' duties.

Within red covers bound by Chicago screws, this 225-page consolidated mimeographed looseleaf book is now in use in 36 AES Branches that ordered copies.

A limited extra quantity of the book is still available at National Headquarters for the accommodation of Branches that have not previously ordered copies. These will be sold to Branches (only), on a first-come, first-served basis so long as that supply lasts, at $5.50 per copy, including postage to one destination.

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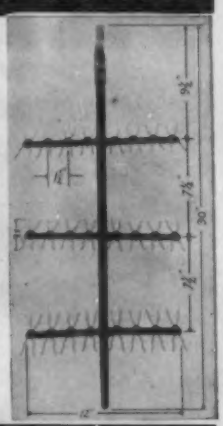

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TRADE ~ LITERATURE

L—201. Parts-Handling Baskets—New information bulletin published by Wire and Iron Products, Inc., describes the wide range of wire parts-handling baskets available for conveying and processing production parts. Also shown are conveyor hooks, plating racks and many special purpose materials handling items developed through the company's diversified facilities for design and production in wire-and-metal fabricating.

Wire machinery guards, conveyor catch guards and other safety products manufactured by the firm are also covered.

L—202. Cleaning Solvent—A new, scented, safety cleaning solvent for wipe or dip cleaning of greasy and oily parts and equipment is described in a technical bulletin by Harco Chemical Co.

Harco Safety Cleaner replaces carbon tetrachloride and other chlorinated solvents and has no flash point under normal usage.

L—203. Barrel Processing—Automatic barrel processing for zinc, nickel, copper, tin and cadmium plating, cleaning, washing, phosphating, stripping and other similar immersion applications are featured in a completely new 14-page comprehensive bulletin made available by Frederic B. Stevens, Inc.

L—204. Electroplating School—A six-page two-color folder describing the inner workings of the Joseph B. Kushner Electroplating School is available. Action photographs show how the school operates, starting from laboratory testing of a plating solution formulation which will appear in the course text, going through preparation and printing of lesson material, marking of student examination papers and shipment of the lessons by mail. Every detail in the operation of this correspondence school devoted to electroplating is covered. Included also is a list of major organizations using this training method for upgrading metal finishing personnel.

L—205. Brushes—A new, two-color, eight-page folder on Situft and Helituf brushes to clean up little jobs that are difficult and time consuming, has just been published by the Osborn Manufacturing Co.

This folder illustrates by copy and photographs, the brushes' characteristics, brush specifications and job applications.

L—206. Wiping Cloths—Descriptive literature has been made available by Textile Products for its Tex-Pro Kwik-Wipe cloth. It is said to be lint free and absorbent. Because it is a disposable product, it is finding wide use in industrial plants.

L—207. Aluminum Bright Dip—An aluminum bright dip used to produce a brilliant lustre on non-silicon aluminum alloys is fully described in Technical Data Sheet No. 21, a two-page usage and instruction sheet prepared by MacDermid Inc. Work processed in Aluminum Bright Dip No. 2, may be handled in baskets, racks, automatically or by hand.

The solution is also used to deburr aluminum by dipping.

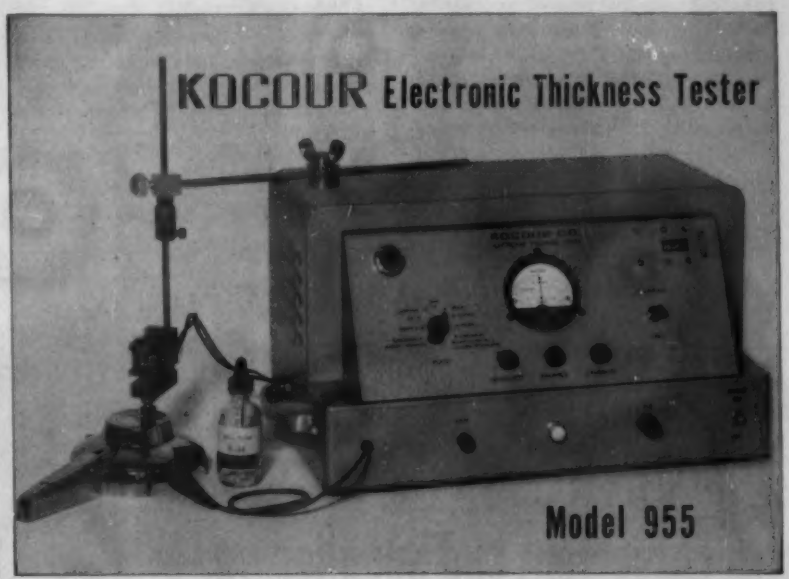
A liquid addition agent, called Aluminum Bright Dip Corrective Solution, for use in nitric-phosphoric acid bright dip baths to restore the lustre producing properties of bright dips is described in Technical Data Sheet No. 2 1B-2, a usage and instruction sheet also prepared by MacDermid.

L—208. Tank Lining—A new Pyroflex bulletin on the properties and use of this acid-proof tank lining is now available.

The eight-page illustrated bulletin gives complete specifications, instructions and application data.

The lining is a compounded flexible sheet lining material developed by the Maurice Knight Co.

L—209. Work Clothes—Advances in acid-resistant and lint-free industrial apparel are described and illustrated in the 1958 edition of Worklon's catalog and information book. It introduces a new group of acid-resistant DuPont dacron work clothes in blue and grey, including shirts, pants, coveralls and laboratory coats. Also presented are new lint-free, acid-resistant DuPont orlon coveralls. Resistance of the various fabrics to acids, caustics and other chemicals is fully presented with laboratory reports relating to technical properties.



Here's a NEW thickness test for COPPER over ZINC DIE-CAST

We are proud to announce the addition of an important new test to the applications of the Kocour Electronic Thickness Tester. You can test copper over zinc die-cast with all the advantages of the instrument, including direct readings in hundred-thousandths of an inch.

MODEL 955 virtually eliminates human error

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 243.

L—210. Abrasive Belt Grinding—Entitled "How Abrasive Belt Grinding Increases Production at Lower Cost", this new two-color 24-page booklet contains over thirty illustrated case histories selected after a survey of Engelberg abrasive belt machine applications. Data include production figures, type of belts used, belt life, fixturing, comparison with prior or alternative methods; and stock removal, tolerance, and finish specifications.

Operating data on ferrous and nonferrous metals, plastics, glass, phenolic laminates, and atomic fuel elements are included.

L—211. Catalytic Coating—Industrial Finishes Co., Inc. now has available an eight-page illustrated color brochure on IFCO catalytic protective coatings. The brochure describes a wide range of its industrial usage and product adaptability.

Characteristics of these coatings are adhesion, durability and wear resistance; one coat application without pretreatment in some cases and an air-drying speed of five to ten min.

L—212. Metal Etch Solutions—A case history of how its sealless plastic pumps resolved the problem of conveying corrosive metal etching fluids for a Westinghouse Electric Corp.'s printed circuit plant has been prepared in a four-page reprint by the Vanton Pump & Equipment Corp.

Illustrated with diagrams that point up the characteristics of the plastic sealless Vanton pump, the case history describes in detail the problem of conveying the corrosive ferric chloride used for printed-circuit etching and its solution.

L—213. Corrosion Resistance—A revised edition of "Corrosion Resistance of Copper and Copper Alloys," 32-page reference booklet, is announced by The American Brass Co. Laboratory research and field study of the nature of corrosive attack on these metals has been conducted for a period of 31 years by the company's technical staff. In the edition just released, latest findings are incorporated in the text of Part I, "Theory of Corrosion and Types of Corrosive Attack."

Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper base alloys when in contact with 186 different corroding agents.

L—214. Tumbling Media—A new folder describing current lines of tumbling media and listing specifications and prices has been issued by the Electro-Minerals Division of The Carborundum Co.

Designed as a vest-pocket reference on tumbling media for superior barrel finishing, the folder describes and lists general applications for aluminum oxide tumbling nuggets, grain and vitrified tumbling pellets, and rubber bonded tumbling media.

L—215. Plating Solutions—"Simple Methods for Analyzing Plating Solutions," a 36-page, two-color booklet is being re-offered by Hanson-Van Winkle-Munning Co.

The bulletin is prefaced by a discussion of analytical principles, use of apparatus and methods for sampling a plating solution. It then outlines in detail the necessary steps involved in 28 analytical methods for testing nickel, copper, silver and other metalfinishing solutions.

Other sections of the bulletin describe necessary equipment, component chemicals of solutions, atomic weights, acid concentrations and electrochemical data. Conversion tables are included. Analytical reagents are listed for brass, cadmium, chromic acid, copper cyanide and sulfate, gold, nickel, silver, tin and zinc plating solutions.

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So as to expedite review and other processing, please write the Editor, PLATING, 445 Broad Street, Newark 2, New Jersey, for full particulars before submitting your manuscript.

PERSONALS

Wm. Grigat

G. A. Schwemer

William Grigat has been promoted to supervisor of an engineering department of Western Electric Co., Kearny, New Jersey, plant. In his new capacity, Mr. Grigat is responsible for metal finishing, plastic molding and tool design. He joined Western Electric 15 years ago upon his graduation from Pratt Institute, Brooklyn, N. Y. with a BA in chemical engineering. Mr. Grigat is president of Newark Branch, AES and a member of Tau Beta Pi. He also serves as an engineer on the Pompton Lakes, N. J., Flood Control Commission.

Glen A. Schwemer has accepted the distributorship of James H. Rhodes & Co. of Chicago for their line of Colossus products, including coated abrasives, steel wool, buffs and pumice.

During the past year, Mr. Schwemer was with R. F. McGuire Co., Milwaukee, where he served as sales manager. Prior to joining the McGuire Co. he managed his own plating firm for fifteen years.

Mr. Schwemer is a member of the AES and a past president of the Milwaukee Branch. He will operate his new enterprise from 2610 N. 118 St., Wauwatosa 10, Wis.

Dr. B. D. Thomas, scientist and research administrator, has been named to the presidency of Battelle Memorial Institute to succeed **Dr. Clyde Williams,** whose retirement as president was announced recently.

Active head of Battelle since being named director a year ago, Dr. Thomas has been a member of the Battelle organization for many years. He joined the staff as a research engineer in 1934, was appointed assistant director in 1942, and vice president in July 1955.

Along with his scientific and technical activities, the new 54-year-old president has carried important administrative responsibilities for most of his 23 years at Battelle. He established and headed its first Division of Chemical Research in 1939, and was a key figure in the establishment of Battelle's research laboratories in Frankfurt, Germany, and Geneva, Switzerland.

Dr. Thomas is a graduate of the University of Washington (BS, 1929; PhD, 1933), where he was awarded a duPont fellowship in chemistry. He is a member of Phi Lambda Upsilon and Sigma Xi. Earlier this year he was granted the honorary degree of Doctor of Engineering by the Michigan College of Mining and Technology "in recognition of high attainments in engineering."

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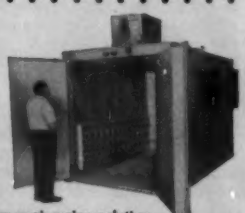

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C. Lowe

K. C. Edson

Clyde Lowe has been named Cleveland representative of MacDermid Incorporated, Waterbury, Conn. Since 1940, he has been associated with Cowles Chemical Co. Prior to 1940, he held a wide variety of positions in the metal finishing industry.

He is now located in the Cleveland area and will work closely with MacDermid distributor salesmen in Ohio and Western Pennsylvania.

Kenneth C. Edson has been appointed Los Angeles District sales manager by Kelite Corporation.

He will be in charge of sales in one of two Los Angeles Districts of the Western Sales Region. His headquarters will be at Kelite's Los Angeles facility.

Mr. Edson's background includes experience in the petroleum and petrochemical industries. He has had 15 years of research, process engineering, customer service, and sales experience with Skelly Oil Co. and the Du Pont Co. A chemistry graduate of the University of Nevada, he has done graduate work at Texas A. & M.

Wilbur H. Brumfield and **Cortez P. Hackett** have been appointed vice presidents of Solvay Process Division, Allied Chemical.

Other changes have included naming of **Clyde A. Kitto** to post of director of operations, **Arnold Hanchett** to director of development and **M. James Campbell** to manager of Solvay's Syracuse plant.

In his new assignment, Mr. Brumfield assumes increased administrative and executive duties in the New York office. As vice president located in Syracuse, Mr. Hackett is in charge of all Solvay's operating and development department functions.

A graduate of Mississippi State College, Mr. Brumfield was first employed by Solvay in 1935 at its Baton Rouge, La. plant. Transferred to the Syracuse plant in 1946, he held various managerial posts there culminating in his appointment to assistant to the director of operations in 1955. Earlier this year, Mr. Brumfield was transferred to Solvay's New York executive office as assistant to the president.

Mr. Hackett, who has been Solvay's director of development for the past four years, has been a Solvay employe since his graduation from Colorado School of Mines in 1932 with a degree of Engineer of Mines. Starting in Solvay's engineering department, Mr. Hackett also had experience in operations during the early 1930's. In 1951, Mr. Hackett became assistant director of development and three years later was made director of development. In addition to this post, he was also elected a director of the Allied Kennecott Titanium Corp. formed in 1956.

The new director of operations, Mr. Kitto, has been manager of Solvay's Syracuse plant for the past year and prior to that managed the company's Baton Rouge plant for six years. A graduate of Michigan State College, he was first employed by Solvay in 1929.

Mr. Hanchett becomes director of development after serving as assistant director since early this year. He obtained his degree in Chemical Engineering at Columbia University and was first employed by Solvay in 1920. Positions held by Mr. Hanchett since then have included plant chemist, project engineer and technical manager.

Succeeding Mr. Kitto as manager of the Syracuse plant is **M. J. Campbell** who has been assistant manager of the plant since 1954. A graduate of Lehigh University with a degree in Chemical Engineering, Mr. Campbell joined Solvay in 1939 and has had supervisory experience in almost all of the major departments of Solvay's Syracuse plant.

H. G. Phillipps Jr. has been appointed manager, Syracuse sales branch, Solvay Process Division, Allied Chemical. Mr. Phillipps succeeds **William E. Hess** who retired Dec. 31 after 27 years as Syracuse sales branch manager.

A graduate of Yale University, with a BS degree, he joined Solvay in 1926 as a salesman. After experience in the New York, Detroit and Cincinnati sales branches, he was named manager of Solvay's Pittsburgh branch in 1948.

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Lloyd R. McCoy, who has headed the technical service section of Diamond Alkali Company's Electro Chemicals Division at Painesville since mid-1956, returns to the company's national headquarters at Cleveland as assistant to the manager of chlorine and hydrogen sales.

Named to succeed him at Painesville as chief of technical service is **Wayne Inbody,** group leader in caustic soda and chlorine research for the past year and a half. At his new post he will be responsible for customer service on chlorine, caustic soda, caustic potash and hydrogen.

Mr. McCoy, a veteran of many years' service with Diamond, and a graduate of Muskingum College, New Concord, Ohio, first became engaged in research development work in 1933, when he joined Federal Laboratories, Inc., Saltsburg, Pa. He was promoted to the post of production manager there three years later.

In 1938 he joined Diamond as a technical sales and service representative on chlorine and in 1942, on leave of absence, he returned to Federal Laboratories to manage certain defense production facilities operated by this firm.

Upon completion of this operation in 1946, Mr. McCoy rejoined Diamond as assistant to the manager of chlorine and hydrogen sales, the position he held until July 1956, when he was transferred to Painesville.

Mr. Inbody joined Diamond as a chemical engineer in May, 1946. He has had wide experience in the use of chlorine, caustic soda, caustic potash and hydrogen.

He was appointed a technical service representative in 1948, and was subsequently transferred from research and development to the Electro Chemicals Division, and in July, 1956 was named group leader in caustic soda and chlorine research.

Prior to joining Diamond, Mr. Inbody for 15 years was associated with E. I. DuPont de Nemours & Co., Inc. in various supervisory capacities, first at Pennsgrove, N. J. and later at Memphis, Tenn. He is a graduate of Tarkio College, Tarkio, Mo.

L. S. Pelfrey

M. L. Reynolds

Lowell S. ("Lou") Pelfrey, who has been active in the development program at International Rectifier Corporation of El Segundo, California since 1953, has been named director of research and development.

Mr. Pelfrey was graduated from the University of Kentucky in 1937, with a BS degree in chemistry, and has been active in the semiconductor field since 1944. At International Rectifier, Mr. Pelfrey performed much original and valuable work in the purifying of germanium and silicon, and in the production of single crystals of these materials. His developments have led to the introduction of several new devices, such as high temperature germanium diodes, germanium mixer diodes for television, and several types of silicon diodes for radar.

M. Les Reynolds, field supervisor for William Lynn Chemical Company of Indianapolis and also a member of the Indianapolis Branch of AES is now president of Reynolds Plastic Company Incorporated, an Indiana corporation organized to manufacture and market reinforced plastic pallets and material handling trays and equipment.

Said to have many advantages over the old-fashioned heavy wooden pallet, the plastic pallet is finding acceptance by users of pallets and trays.

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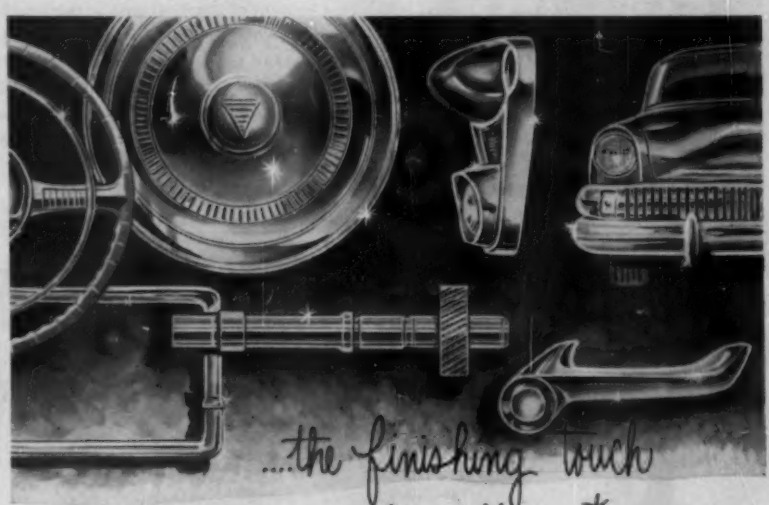

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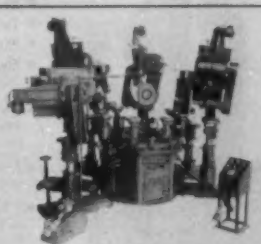

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BOOKS

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Engineering Materials Handbook. Prepared by a Staff of Specialists. Charles L. Mantell, Editor. 1936 pages. 648 illustrations. Nonmembers, $21.50; Members, $19.35.

Engineering materials are tied in very closely to specifications, tests, standards, and the like in this new and completely up to date Engineering Materials Handbook. A comprehensive and authoritative reference, it considers materials from the viewpoint of engineering structures, machinery and equipment. Gathered together in this one volume is the kind of information required by anyone concerned with planning design, structure, manufacturing and serviceability.

In 43 well organized sections, the handbook covers metals, the organic and inorganic materials, and the cause and prevention of failure in materials. Technical tables, design information, structural characteristics, and tabular data make a wealth of useful and specific facts quickly available. A high degree of reliability is achieved by coordinating the work of more than 150 contributors, each a specialist in his own field.

The first section embraces not only the ferrous metals, the related stainless steels, all base metals, and the precious ones, but also those which are considered uncommon, since a number of these are rapidly reaching commercial importance and production.

Special sections also deal with the materials of construction of apparatus for control and utilization of atomic forces and fission products: power plants, reactors, their safety and insulation against X-rays, gamma rays, beta particles, and all the products of fissionable material. Elsewhere, new concepts of material utilization in rockets are contrasted with industrial applications.

The task of coordinating and editing the vast amount of practical data in this handbook was done by Dr. Charles L. Mantell. Chairman of the Department of Chemical Engineering at the Newark College of Engineering, Dr. Mantell is well known as an industrial consultant and has served as a consulting engineer to a number of governments and their agencies.

Investigation of the Applicability of High Frequency Sound Waves (Ultrasonics) for Cleaning of Precision Parts. O. E. Mattiat and P. P. Zapponi, Clevite Research Center for Wright Air Development Center. June 1957. 76 pages. Order PB 131361 direct from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., $2.

Accessible soils of all kinds are shown to be easily removed from small precision parts by the ultrasonic systems studied. Inaccessible soils, such as steel particles in bearings and grease in blind holes, require high sonic intensities and a coupling fluid with optimum cavitating and solubility or dispersability properties for the particular soil. Low frequency systems appeared more effective than high frequency systems for removing most soils investigated. Those included greases, burnt-on carbon, lapping and buffing compounds, steel particles, and a synthetic soil. It was further observed that bearing damage resulting from ultrasonic treatment is insignificant for the short cleaning times normally required. Processes are recommended for cleaning precision parts and bearings. A coupling fluid—trichloroethylene—is shown to be best for removal of soils. The steel-removal and probe methods, two new processes for evaluating ultrasonic systems and factors, are described.

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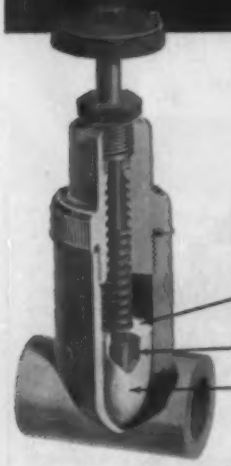

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ARTICLE REFERENCES

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Most of the articles listed here may be obtained by writing to the publications in which the articles were published. Addresses are given at the end of the references for the reader's convenience.

Photostat or microfilm copies of articles in available magazines may be obtained from: Library of Congress, Washington, D. C.; New York Public Library, New York; Engineering Societies' Library, New York, at prevailing rates. In other cases, consult Wilson's Union List of Serials at your nearest public library for other sources of these articles.

13. CLEANING

a. *ULTRASONIC CLEANLINESS IMPROVES FINISH, SAVES TIME AT BEARING PLANT.*
A. R. McCloskey.
Ultrasonic News, December 1957, pp. 18–19.

b. *ULTRASONICS SPEED METER REGISTER CLEANING AT LONG ISLAND LIGHTING.*
J. W. Dye and A. Howard.
Ultrasonic News, December 1957 pp. 20–21.

14. CORROSION

a. *COMPATIBILITY OF ALUMINUM WITH ALKALINE BUILDING PRODUCTS.*
C. J. Walton, F. L. McGeary and E. T. Englehart.
Corrosion, *13*, No. 12, December 1957, pp. 41–50.

b. *THE INFLUENCE OF SURFACE PRETREATMENT ON THE ATMOSPHERIC OXIDATION OF 2S (U. S. ALLOY 1100) ALUMINUM.*
Philip M. Aziz and Hugh P. Godard.
Journal of the Electrochemical Society, *104*, No. 12, December 1957, pp. 738–739.

c. *CORROSION RESISTANCE OF COBALT.*
R. S. Young.
Corrosion Technology, *4*, No. 11, November 1957, pp. 396–397.

15. ELECTRODEPOSITION

a. *ELECTROPLATING FROM THE PYROPHOSPHATE BATH. 1. ELECTRODEPOSITION OF SINGLE METALS.*
T. L. Rama Char.
Electroplating and Metal Finishing, *10*, No. 11, November 1957, pp. 347–349.

16. FINISHING

a. *SURFACE FINISHING FORMED STEEL SHAPES.*
Gerard H. Poll, Jr.
Products Finishing, December 1957, pp. 42–47.

b. *THE NATURE OF MECHANICALLY POLISHED METAL SURFACES: THE SURFACE DEFORMATION PRODUCED DURING THE ABRASION AND POLISHING OF ZINC.*
L. E. Samuels and G. R. Wallwork.
The Journal of the Institute of Metals, *86*, September 1957, pp. 43–48.

17. GENERATION

a. *MOTOR GENERATORS FOR ELECTROPLATING.*
H. E. Head.
Products Finishing, December 1957, pp. 54–62.

18. METAL COATING

a. *METAL SPRAYING—DEVELOPMENT AND APPLICATION.*
S. J. Oechsle, Jr.
Metal Finishing, 55, No. 12, December 1957, pp. 67–71.

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19. MISCELLANEOUS

a. *A NEW WAY TO SELECT WEAR-RESISTANT MATERIALS.*
J. R. Driear.
The Iron Age, *180*, No. 21, November 21, 1957, pp. 121–122.

b. *COMPRESSED AIR AND ITS APPLICATION IN METAL FINISHING.*
James Robertson.
Electroplating and Metal Finishing, *10*, No. 11, November 1957, pp. 366–373.

c. *INFLUENCE OF CRYSTAL FACE ON THE SURFACE PROPERTIES OF METALS.*
A. T. Gwathmey.
Corrosion, *13*, No. 12, December 1957, p. 40.

d. *MECHANICAL SPRINGS—MATERIALS, FINISHES AND EMBRITTLEMENT.*
Lester F. Spencer.
Metal Finishing, 55, No. 12, December 1957, pp. 56–60.

20. ORGANIC APPLICATION

a. *NEW PAINT SHOP AT BRIGGS MOTOR BODIES LTD., SOUTHAMPTON.*
Electroplating and Metal Finishing, *10*, No. 11, November 1957, pp. 351–362.

b. *SCIENCE FOR THE COATINGS TECHNOLOGIST. PART VIII. GREEN PIGMENTS.*
E. S. Beck.
Metal Finishing, 55, No. 12, December 1957, pp. 61–62.

c. *A SURVEY OF PAINT APPLICATION METHODS.*
Ezra A. Blount.
Products Finishing, December 1957, pp. 25–34.

21. WASTE

a. *HOW TO DISPOSE OF CYANIDE PLATING WASTES.*
B. H. Robbins.
The Iron Age, *180*, No. 22, November 28, 1957, pp. 92–94.

b. *SCIENCE FOR ELECTROPLATERS. 31. CYANIDE WASTE TREATMENT—CHLORINATION.*
L. Serota.
Metal Finishing, 55, No. 12, December 1957, pp. 77–80.

The following are metallurgical abstracts taken from The Journal of the Institute of Metals, September 1957, pp. 30, 34, and 35:

Corrosion-Resistance of Electroless Nickel. (Metal Ind., 1957, 90, (6), 111). Describes the corrosion-resistance of Kanigen Ni coatings (7 wt.-%P) and tabulates the penetration of acid and alkaline media.

The Surface Treatment of Titanium. H. Richaud (Corrosion et Anti-Corrosion, 1956, 4 (11), 400–402; and (abridged translation) in Metal Ind., 1956, 89, (24), 496). Pickling can be carried out in two aq. baths: (a) HCl (22 Be′) 15 per cent, HF (40 per cent) 3–5 per cent, by vol. at 20–25 C; (b) HNO_3 (40 Be′) 20 per cent, HF (40 per cent) 1–3 per cent. Bath (a)

PREVIEW OF FUTURE PLATING ISSUES

MARCH 1958

ORGANIC COATING. As last year's edition, this issue will feature organic finishing.

APRIL 1958

TECHNICAL RESEARCH. Not only will this issue spotlight recent developments in the AES Research Program but will also be the pre-1958 ANNUAL CONVENTION feature issue.

MAY 1958

CONVENTION ISSUE. Inasmuch as the 1958 Annual Convention will be held in Cincinnati, Ohio, May 19–22, this feature issue will come in May instead of June as customary.

JULY 1958

POST CONVENTION ISSUE. Among other features, it will contain a pictorial and narrative account of the 45th Annual Convention.

AUGUST 1958

WATER AND WASTE TREATMENT. Another edition of this informative and popular feature.

NOVEMBER 1958

AIRCRAFT. Electroplating and metal finishing in the aviation industry will be featured in this second annual edition.

THE JUNE, SEPTEMBER, OCTOBER and DECEMBER issues loom as strong 1958 General Issues.

gives a matte and (b) a smooth, light-grey finish. Anodic oxidation at 18 v. and 20 C in H_3PO_4 + 20 wt.-% H_2SO_4 (66 Be') gives yellow to violet colours, depending on the oxidation time. These oxide films are not electrically insulating. Zn can be deposited by electrolysing for 5–10 min at 20–25 C, using a cd of 1 amp/dm² at 5 v and a graphite anode in a bath containing ZnF 100 g, HF (40 per cent) 200 cc, ethylene glycol 800 cc. A similar bath with the current reversed will deposit Zn on a Ti oxide film, giving particularly good adherence. Thicknesses up to 40μ of Cu, brass, Sn, Cd, Ag, Ni and Cr were obtained using conventional plating baths. Details are given of a means of Ag-brazing Ti sheet by depositing a layer of Zn followed by alternate layers of brass (6μ) and Ag (8μ). The sheets were then pressed together and heated at 800 C for 30 min. The tensile strength was 2 kg/mm² of contact surface.

Thermodiffusion Plating of Metals. N. A. Izgaryshev (Trudy Komissii po Bor'be s Korroziei Metal. Akad Nauk S.S.R.R., 1956 (2), 149–154; C. Abs., 1957, 51, 6484)—(In Russian). In the thermodiffusion method of plating, a chloride of the plating metal is produced at high temperature; the gaseous chloride is made to diffuse into the metal to be plated; the diffusion produces surface layers composed of a metallic compound, increasing the resistance of the original metal. The technique and results of this method of plating were investigated with different metals. Cr was plated by using $CrCl_3$ in a Cl atmosphere. The optimum temperature range was 850–1000 C. The average concentration of Cr in the layer penetrating 0.2 mm in depth of Fe was 15 per cent, but the surface layer was much richer. It consisted of a solid solution of Fe and Cr with traces of carbide in the case of high-C steel and was perfectly corrosion-resistant in air saturated with water vapour carrying 1 per cent H_2S or SO_2. The plated metal withstood heat-treatment and even rolling. Al plating was done at 1000 C with $AlCl_3$ gas. The layer obtained was resistant to high temperature. Of special interest were the highly resistant layers of a mixture of Al + Cr. Also Cr + Ag layers 0.183 mm thick were obtained; the protection against 3 per cent NaCl solution was perfect. Mo + W and Sn + Cu plating was also successfully achieved.

The following are Metallurgical Abstracts taken from The Journal of the Institute of Metals, November 1957, pp. 187–191:

Internal Stresses in Electrodeposits. I. Stresses in Zinc Deposits. K. M. Gorbunova and O. S. Popova (Zhur. Fiz. Khim., 1956, 30, (2), 269–276). (In Russian.)

Some Problems Concerning the Theory of Electrodeposition of Alloys. I. Methods of Calculating the Potential Shift of Ionic Discharge Due to the Energy of Mixing on Formation of an Alloy. Yu. M. Polukarov and K. M. Gorbunova (Zhur. Fiz. Khim., 1956, 30, (3), 515–521). (In Russian.)

Electrodeposition is possible of alloys of metals that cannot be electrodeposited as single metals, but very little is known of the structure of such alloys. It is not sure whether the electrodeposit is a mixture of crystals of pure metals, a solid solution, or an intermetallic compound. During electrodeposition of alloys the transport of ions can occur at potentials slightly different from those in solution of the metals alone. In this connection it is important to evaluate the "energy of mixing" by theoretical or experimental means. Evaluation of potential shift by calculation of energy of mixing is given by $E = \psi/\eta F$. Thermodynamical calculations should be made on the basis of differential heats and in the equations the concentration should be disregarded. For the alloys Cu-Ni, Ag-Pd, Ag-Au, Cu-Pd, there is a good agreement between theoretical and experimental values. 21 ref.

In connection with the above refer to the following:

Some Problems Concerning the Theory of Electrodeposition of Alloys. II. Investigation of Shift of Potential of Ionic Discharge During Formation of an Alloy. Yu. M. Polukarov and K. M. Gorbunova (Zhur. Fiz. Khim., 1956, 30, (4), 871–877). (In Russian.)

Some Problems Concerning the Theory of Electrodeposition of Alloys. III. Conditions of the Relation of the Deposition Potential of Metals to the Energy Set Free During Formation of an Alloy. Yu. M. Polukarov and K. M. Gorbunova (Zhur. Fiz. Khim., 1956, 30, (4), 878–881). (In Russian.)

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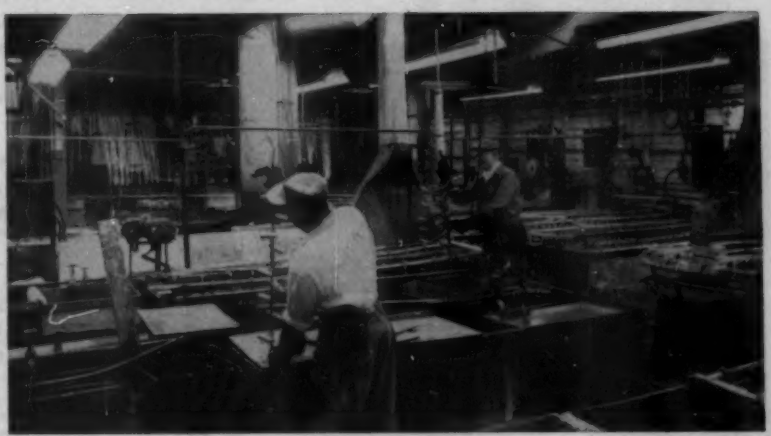

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BRANCH NEWS

Total AES Branches U. S., Canada, Australia, January 1, 1958—57.

BLUE RIDGE

Mungenast Speaks on Rectifiers and Members Tour GE Plant

The monthly meeting was held Dec. 13, 1957, at General Electric Rectifier Division, Lynchburg, Va., **N. F. Murphy** presiding.

The meeting began with a dinner at the Virginian Hotel where the forty members and visitors were welcomed as guests of General Electric.

Special guests of General Electric **A. J. Fielder,** professor of Physics and **Tom Sweeney,** a student, were welcomed.

Three new members were elected.

Howard Welfare brought to the attention of the group the need for support of the Southeastern Branch annual meeting in advertising and attendance.

P. D. Callahan introduced **John Mungenast** as speaker of the evening. Mr. Mungenast outlined the program and the meeting adjourned to G. E.'s Rectifier plant, west of Lynchburg. Mr. Mungenast gave an illustrated lecture on the history of germanium and silicon rectifying cells. A tour followed of the assembly lines where rectifiers, transformers and reactors are made and tested.

The next meeting was announced to be held in Roanoke, Jan. 10, 1958 at Carlton Terrace Hotel.

Carl A. Witherspoon
Secretary-Treasurer

BOSTON

New Officers; Tumbling and Barrel Finishing Presented by McNally

Boston Branch met Thursday, June 6, 1957 at the Hotel Statler with President **Flores** in charge. **Manson Glover** had an announcement presented inviting all members of Boston Branch attending the Montreal Convention to attend a Glover Coating Co. luncheon. Three new members were elected and one transfer accepted.

Officers elected were President **Elston A. Flores;** First Vice President, **John Wright;** Second Vice President, **Hubert H. Foley;** Sergeant at Arms, **Hilton M. Smith;** Librarian, **F. Wayne Martin;** Secretary-Treasurer **Dr. George P. Swift;** Board of Managers, **Louis J. Love, James H. Anderson, Myer Shapiro** and **Andrew W. Garrett.** Mr. Glover installed the complete group.

Wayne Martin then presented **Charles McNally** of the M. E. Baker Co. of Cambridge, Mass., discussing Tumbling and Precision Barrel Finishing. The types of barrels, abrasives, packing media and compounds were discussed in some detail followed by a discussion on how to separate the product from the media.

Hand methods of finishing was compared to corresponding finishes from tumbling operations.

The meeting adjourned at 9:30 p. m. to partake of beer, coffee, coke and sandwiches as guests of Boston Branch.

George P. Swift
Secretary

BOSTON

Diggin Discusses Nickel Plating

Boston Branch met Thursday, Oct. 3, 1957 at the Hotel Statler with President **Flores** in charge.

The transfer of **Hilton Smith** to Milwaukee required a vote on a new Sergeant-at-Arms. **Joe Whalen** of Raytheon was duly elected and installed.

On motion of **Manson Glover,** it was voted to postpone indefinitely the election of a new delegate slate.

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President Flores announced the appointment of **Hugh Foley** as 1958 Annual Meeting Chairman. **Lou Gagnon** reported on the acceptance of Boston's invitation for the National Convention to be held in Boston at the Statler in 1961.. Mr. Glover reported on the 1957 Annual Business Meeting at Montreal.

Wayne Martin presented **Myron B. Diggin** of the Hanson-Van Winkle-Munning Co., who spoke on 'Nickel Plating.'

As usual, he covered completely developments and the need for higher current densities for heavier nickel deposits, abandonment of the copper undercoat, shorter plating conveyors, increased brightness and leveling to lower buffing costs, better distribution of deposits and the need for better or improved physical properties.

He used slides to show just how these matters were currently being attacked in the laboratory or in the field. One item of particular interest causing extra comment was the relation of lamellar structure to corrosion resistance.

George P. Swift
Secretary

BOSTON
Ten New Members; Korbelak is Speaker

Boston Branch met Thursday, Nov. 7, 1957 at the Hotel Statler with President **Flores** in charge. Ten applications for membership were read, accepted and favorably voted.

Wayne Martin presented **Al Korbelak** of Sel-Rex. He discussed Electroless Gold and Gold Alloys.

Al showed that to date, there is no true electroless gold deposition but rather immersion golds using sequestering agents. Current practice in this field together with applications were discussed and then followed with alloy gold deposits in thicknesses in excess of 0.0015 in. Elements alloyed with gold to increase hardness were discussed. Color applications and uniformity of deposit as well as a better corrosion resistant finish was discussed as related to rolled and gold filled articles. Tanks, agitation and control were discussed in some detail. Current changes in the Federal Trade Commission rulings were discussed.

George P. Swift
Secretary

BRITISH COLUMBIA
Tour Research Council

The final meeting of 1957 consisted of a tour on Dec. 16 of the facilities of the British Columbia Research Council located on the University of British Columbia campus.

Messrs. **Crawford, Cave** and **Wright** of the council conducted three separate groups of society members and their wives through all the departments in their building—including Terredo control, metal analysis, chromatography, spectrum analyzer, library, metal fatigue, tantalum oxide coating and X-ray.

Following the tour the members journeyed to the nearby Dolphins Restaurant where a short meeting, followed by light refreshments, completed a very interesting evening which was informative as well as entertaining.

J. Lee, *Secretary*

CENTRAL MICHIGAN
Ultrasonic Cleaning Presented by Jacke

The regularly scheduled monthly business meeting and educational session of the Central Michigan Branch, AES was held on Tuesday evening, Dec. 3, 1957 at the Roosevelt Hotel in Lansing, Michigan.

President **R. W. Boos** called the business meeting to order following dinner. Twenty-four members and guests were in attendance.

S. E. Jacke of the Detrex Chemical Industries, Inc. was the featured speaker for the educational session. His topic was "Cleaning Metals With Sonic Waves". The subject was well presented with both slides and visual demonstration equipment. Many questions were ably and clearly answered by Mr. Jacke.

Homer E. Welch
Third Vice President and Publicity Chairman

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CHICAGO

Marzano Presents Plating of Difficult Metals

The Dec. 13, meeting of the Chicago Branch was held at Stauffer's restaurant at 26 West Madison Street in Chicago. The meeting was well attended. A short film was shown preceding the technical program, describing the building of the DEW Line near the Artic Circle. The film was the property of the Western Electric Co. who were prime contractors for the installation of the radar line.

The speaker of the evening was **Christopher Marzano,** our publicity chairman and director of the Chemical Laboratories at Amphenol Electronics Corp. The subject was "How to Plate Difficult Metals". Mr. Marzano received his Masters degree from the University of Michigan. His wide experience in both production and research make him well qualified to cover this topic.

Some of the metals discussed were (1) high aluminum silicon bronzes (2) highly leaded brasses (3) beryllium and tellurium copper (4) slush castings (5) case hardened and high carbon steels (6) high nickel alloy steels (7) monels, inconels, hastelloys and their treatment prior to plating (8) plating on molybdenum and titanium (9) plating on zinc die cast and magnesium parts.

Mr. Marzano used slides, showing the steps involved for preparing each of the above base metals for plating. The information was greatly appreciated by the members present. In answer to the many requests for copies of this paper Mr. Marzano has agreed to prepare this paper for publication.

After a very lively and interesting question and answer period the meeting was dismissed with a rising vote of thanks.

J. C. Corre
Librarian

CINCINNATI

Annual Ladies Night

Sixty-three members, their wives and guests met at the Engineering Society Headquarters on Dec. 18 for our annual Ladies Night. After a delicious dinner, President **Loveless** presented the Past President's pin to **Ed Roof.** Then **Mrs. Bob Miller** and **Chuck Wise** briefed the group on the progress of the 1958 National Convention.

The evening was completed with dancing to the dixieland music of the Gin Barrel Seven. Needless to say there were quite a few tired and sore AES members the next day. The Social Hour was sponsored by the Buckeye Products Co.

D. L. Kaplan
Secretary

CLEVELAND

Doyle Speaks on Plating Wastes

The subject of interest at the December monthly meeting was the Chlorination of Cyanide Plating Wastes. The meeting was held on December 6 at the Hotel Carter.

Speaker for the evening was **B. J. Doyle,** local representative of the Wallace and Tiernan Co. A discussion of the chemical reactions involved in the chlorination and hypochlorination of various cyanides was held. In addition, a flow diagram illustrating a set-up for the destruction of cyanide wastes in a small job shop was presented.

The technical session of the meeting was under the direction of **Jack Winters.**

Announcement of the Annual Dinner Dance was again made. It will be held at the Hotel Carter on February 15, with an interesting technical session, prior to the dinner, as a highlight of the day.

Gordon H. Carlson
Assistant Librarian

COLUMBUS

Joint Meeting Hears Baker on Titanium

The regular monthly meeting was held on Thursday, Dec. 12, 1957 at Grandview Inn. It was a joint meeting with the

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AIME and the Electrochemical Society.

After the dinner **Dr. Mars Fontana** introduced the speaker, **Donald H. Baker Jr.** of the U. S. Bureau of Mines who spoke interestingly on "Electrorefining Titanium."

Halvor S. Christianson
Secretary

HAMILTON
Hart Discusses Bright Nickel Plating

The Nov. 15 meeting was held in St. Catherine's, Ont. at the Leonard Hotel with members from Hamilton, St. Catherine's and Toronto attending.

President **B. Teal** called the meeting to order and after a short business meeting **K. Taylor**, librarian, introduced the speaker, **Jack Hart**, from Hanson-Van Winkle-Munning Co., Detroit. Mr. Hart spoke with authority on the Development of Bright Nickel Plating over the years.

D. Darby
Recording Secretary

LANCASTER
Schick Plant Visitation

The regular meeting of the Lancaster Branch was held on Dec. 13 with 34 members present.

The program included a dinner in the Schick Incorporated cafeteria and a short business meeting at which time six new members were elected giving the Branch a total of 73 active members.

Curvin Miller, Branch president, spoke briefly concerning the moving of **Ray Vines**, one of our active members, to another state. During Ray's membership in the Lancaster Branch he took a very active part in our Branch activities. At the time of his moving Ray was serving on the Board of Managers.

The meeting concluded with a plant visitation through the new Schick Incorporated plant, Lancaster, Pennsylvania.

Robert S. Plaisted
Secretary

LOS ANGELES
1960 National Convention Chairmen Appointed

The regular monthly meeting of the Los Angeles Branch was held at the Rodger Young Auditorium on the evening of Wednesday, Nov. 13, 1957.

The business meeting was called to order by our president, **George Magurean**. There was a total attendance of 104 members and guests. The guests, eleven in number, were introduced by Sergeant-at-Arms **Milton Weiner**.

George Hetz, co-chairman of the 1960 Convention, announced the appointment of the various Convention Chairmen. They are: Banquet, **H. Smallman**; Educational, **Earl Arnold**; Entertainment, **Larry O'Neil**; Hotel, **Larry Henderson**; Housing, **Marty Barsoom**; Finance, **W. Balendorf**; Ladies Activities, **Mrs. G. Beckwith**; Outings and Transportation, **T. Stoner**; Registration, **Phil Simon**; Plant Visitation, **H. Hunt**; Program & **J. Millhorn**; Publicity, **E. Wells**; Printing, **S. Krentel**; Metal Finishing Suppliers' Association Activities, **H. J. Struckhoff**.

Tony Stabile, the general chairman, and his co-chairman have been very busy during the past several months and have chosen a very excellent group of chairmen for the National event.

The death of John Millhorn's father was then announced. John is a well known member of the Branch and throughout the industry in Southern California. We all regret the sad news.

Our 1st vice president, **Norman McEwan**, introduced six prospective members for consideration by the Board of Governors and six new members were inducted into membership.

With no additional old business and no new business, the speaker was introduced by **Frank Virgil**, our librarian. The speaker for the evening was **J. E. Mungenast**, engineer with the Rectifier Division of General Electric Co. He gave a very interesting and informative talk on the development and uses of the germanium and silicon rectifiers not only in

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electroplating, but in various other electro-chemical uses. His presentation also brought us up to date on the latest slide projection techniques as his talk was supplemented with cinemascope size color slides which were excellently done.

The question and answer period which followed showed that plating power supplies are still a source of great interest to everyone and Mr. Mungenast did a very capable job of informing us about the present capabilities of the rectifier equipment, its uses, installation, care and maintenance.

Emmett H. Babcock
Secretary

MONTREAL
Diggin is Speaker; Get Together Party Scheduled

The Dec. 2 meeting was brought to order by President **P. M. Coady** with 18 members present.

Librarian **J. Rennie** was asked to introduce the speaker for the evening, **Myron B. Diggin** of Hanson-Van Winkle-Munning Co.

The speaker gave a most interesting talk on "Recent Developments in Bright Leveling Nickel Deposits", complete with slides. He then answered questions put to him by the members and was thanked on behalf of all by **J. T. Reisenburg Sr.**

After a short recess the meeting resumed for the business session.

Report on the dance was given by **N. Cronin** who reported it was a complete success in every way. **B. Lafond** read the financial report on the dance, showing a profit. A vote of thanks was proposed to the dance committee by President Coady.

Interim meeting in Indianapolis: It was moved by **W. Glover** seconded by **S. Frost** that representation be witheld until an Interim Meeting is held closer to home.

The January 13 meeting will be in the form of a get together party. Messrs. **Rennie** and **Cronin** were appointed by President Coady as a committee of two to to run it.

W. T. Scott
Secretary-Treasurer

NEWARK
Annual Christmas Party Enjoyed by Over 300

A meeting of the Newark Branch was held on Friday, Dec. 13 with President **Grigat** presiding. Seventy were in attendance—including visitors **Herberth Head,** National First Vice President, **Dr. George P. Swift,** National Past President, and Messrs. **Kane** of Montreal, **Lee** of Waterbury and **Benner** of New York.

Five membership applications were accepted and three new members were elected.

Gus Bittrich reported all set for a grand Christmas Party on the 14th and **George Wagner** gave a financial report which showed the Branch's assets in excellent shape.

Librarian **Fred Myer** introduced **Hy Koretzky** of Hanson-Van Winkle-Munning Co., whose timely topic was Waste Disposal Problems. He reviewed quickly the waste disposal situation and then described an unexpected complication that caused difficulties in one instance. This was the appearance of hexavalent chromium in a treated cyanide effluent. Since all chromium wastes had been segregated, the problem was serious until it was found chromium dragged into the copper cyanide bath was oxidized by the chlorine used for cyanide oxidation, requiring revamping of the disposal plant.

Robert Goodman of E. I. duPont de Nemours and a member of Newark Branch then discussed Effects of Impurities in Cyanide Plating Solutions. Particular reference was made to cyanide zinc and copper solutions.

Robert E. Goodman, left, duPont, and Herman Koretzky, H-VW-M Co., Speakers at the Newark Branch 44th Annual Educational Session.

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A very limited quantity also exists of the 1956 Edition. Domestic price is $12.50 per copy; foreign $15 per copy. All orders must be accompanied by payment in full.

Newark Branch members and guests at the Branch's 44th Annual Educational Session at the Robert Treat Hotel, Newark, N. J., Friday evening, December 13. The Annual Banquet was held the following evening.

Newark Branch Officers, left to right, Dodd S. Carr, second vice president; Fred Meyer, librarian; John Banta, sergeant-at-arms; George J. Wagner, treasurer; Gustave Bittrich, first vice president; D. Gardner Foulke, secretary; William Grigat, president.

The meeting adjourned with less tarrying than usual—the members hurrying home for a good rest prior to the Christmas Party held the next evening.

The Newark Branch Christmas Party got under way in a fine manner with MFSA members Enthone, Inc., Frederick Gumm Chemical Company, Hanson-Van Winkle-Munning Co., and Udylite Corporation sponsoring a joint cocktail party. Promptly at 8 p. m., the 325 in attendance moved into the Ballroom of the Robert Treat to enjoy a roast beef dinner. The entertainment with Jerry Tolman as Master of Ceremonies, Nelson and Elliott, songsters, and Bob Howard, pianist and singer, put everyone in a holiday mood, so much so that the dance floor remained crowded until closing at 2 a. m. The Banquet Committee, particularly Chairman Gus Bittrich and Entertainment Chairman **Louis Donroe**, did a fine job much appreciated by the Newark Branch.

D. Gardner Foulke
Secretary

PHILADELPHIA
Panel Discussion
Proves Informative

The regular meeting was held on Dec. 16 at the Engineers' Club with 32 at dinner. At the start of the business meeting, attended by about 70, Branch President **Farren** had each one introduce himself. The reading of the minutes of the previous meetings and the treasurer's report were dispensed with. First Vice President **Cogan** reported on the AES Membership Committee meeting held in Detroit Dec. 7 and plans discussed for membership promotion.

A tentative reservation for the 1958 Banquet had been made with the Sheraton Hotel for Nov. 1. This date was accepted by unanimous vote. Six active members were admitted.

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The secretary reported on the changes in dues billing for 1958–59 because of the change in the beginning of the fiscal year from April 1 to July 1.

The educational portion of the meeting consisted of a panel discussion with **Dr. Samuel Heiman** as moderator. The following members of the Branch each introduced their subject with a short talk and then answered questions from the audience. The members of the panel and their topics were: **Edward M. Hoffmann, Jr.,** Accurate Electroplating Co., "Chromium Plating"; **I. William Marcovitch,** American Machine & Metals, Inc., "Specification Plating"; **Herman P. Wright,** Ternstedt Division, General Motors Corp., "Plating of Zinc Die Castings"; **Edwin F. Ottens,** Philco Corp., "Zinc and Cadmium Plating".

Lively discussions following the panel's talks indicated the interest of those present in the subject matter covered. The moderator with reluctance concluded the session at 10:15 p. m. Comments heard after the meeting agreed that the panel and discussion program was of much value in evoking good, solid plating information and should be continued annually as a regular feature.

I. Wm. Marcovitch
Secretary

ROCKFORD

The regular monthly meeting was held Monday, Dec. 9 in the Winnebago Room of the Faust Hotel.

Thirty-six were on hand to enjoy a fine meal and about 49 were present for the meeting which followed.

In the absence of our president, the meeting was conducted by **Stuart Golding,** first vice president. After a short business session the meeting was turned over to **Bob Twyning** who introduced **Roy Buckrop,** physicist of the Bendix Aviation Corp. His topic was "Ultrasonic Cleaning and Electroplating".

After a superb presentation of his paper, Mr. Buckrop answered all questions. From the amount of questions asked and the lively discussions on them the speaker had a tremendous workout. The Rockford Branch is indeed debted to the Bendix Corp. and the speaker for so graciously allowing us this opportunity.

March 15 is the date for the annual Educational Session and Banquet.

Ellsworth J. Budden
Secretary-Treasurer

ST. JOSEPH VALLEY
Tour Bendix Plant; Advanced Electroplating Course Organized

A record number of 83 members and guests attended the November meeting of the St. Joseph Valley Branch. The meeting was called to order by President **Art Weigand.** He read a letter from **Paul Glab,** Chicago Branch secretary, concerning the appointment of delegates from our branch to assist in the planning for the 1962 convention.

Six new members were elected and two applications for membership were read and approved.

National Second Vice President **"Duke" Wysong** spoke on the plans for the Interim Meeting to be held in January with the Indianapolis Branch as host. He urged all delegates and alternates to exert every effort to attend.

Dr. H. J. Wiesner, who conducted a very successful Electroplating Course last year, assigned Wednesday, Nov. 20 as the date for the organizational meeting for this year's course. The course will be somewhat more advanced and is designed as a follow-up for the one presented last spring. The meeting was adjourned at 8 p. m. and reconvened at the Bendix Products Division of the Bendix Aviation Corp. A conducted tour through both the automotive and aircraft products division proved to be extremely interesting.

Bendix is one of the largest manufacturing plants in this area. A variety of finishing and plating operations are performed on automatic and semi-automatic equipment. Thus, the group was able to observe a number of unique techniques not common to the smaller plants or plating shops.

The tour consumed about an hour and a half and was thoroughly enjoyed by all in attendance.

Henry A. Meers
Secretary

SAINT LOUIS

The regular monthly dinner meeting was held at the York Hotel, December 11. There were 23 members and guests present for dinner. The meeting was called to order by President **McAlister** with 30 members and guests in attendance.

Three new members were accepted.

A letter from the Chicago Branch was read giving the details of the forthcoming Educational Session and Banquet. Notice of the Interim Meeting at Indianapolis was made. **A. P. Julius** reported he had received a letter from the St. Louis Convention Bureau. They assured him that St. Louis could handle the National Convention and handle it well. Mr. Julius suggested it would be in order to have an Interim Meeting in St. Louis between now and then. A discussion followed pertaining to the expenses of the delegates attending the interim meetings. Ruel Shumway suggested the branch should offer assistance to the delegates. **Louis Berra** (treasurer) suggested we should not lose sight of the fact that most of the money in the treasury was a fund for the spring banquet.

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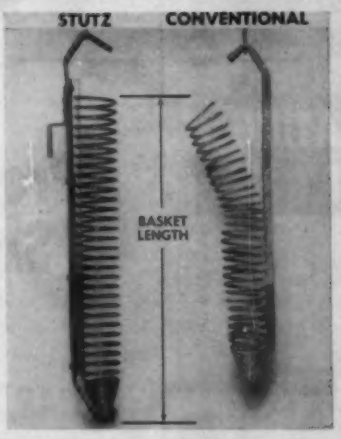

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James Kelly made a motion that the delegates going receive 20 dollars from the treasury. Seconded by Ruel Shumway. Passed with our opposition. Dr. A. M. Max invited those going to the Interim Meeting to the Indianapolis Branch meeting and dinner Friday, Jan. 10.

Librarian **Ruel Shumway** introduced the speaker of the evening, Dr. Max, director of research at the RCA Victor Record Division in Indianapolis. Dr. Max, an active member of the Indianapolis Branch, spoke on Contributions of Plating to High Fidelity. He introduced a film depicting how records are made and conducted a question and answer period.

Ward W. Kelly
Secretary

SOUTHEASTERN

Charter Members' Night Held on 11th Anniversary

The Southeastern Branch held its regular meeting on Dec. 13 at the Belmont Steak House in Atlanta. Thirty-five were in attendance with **Charles I. Lewis** presiding.

Two new members were accepted. It was Charter Members' night so charter members in attendance gave short talks about the history of the branch. These charter members were: **M. E. Awtrey, Clyde Stovall, William T. Weymouth** and **H. R. Stogner Sr.**

George W. Taylor reported on the activity of the first meeting of the New National Membership committee held in Detroit on Dec. 7.

The Southeastern Branch 3rd Annual Technical Session, with participation from Blue Ridge Branch and Miami Branch, scheduled for Feb. 14 and 15 will be the biggest Regional plating meeting ever to hit the South. Speakers for the occasion will be **R. V. VandenBerg** of Alcoa, **Dr. Richard B. Saltonstall** of Udylite, **Clarence H. Sample** of International Nickel, **Henry Mahlstedt** of Metal and Thermit and **Walter Pike** of H-VW-M Co. A tour of the main plant of Scripto is arranged.

The speaker for the evening was **R. J. Hafer,** chief finishing engineer, Reynolds Metals Co., who spoke on anodizing aluminum.

"Southeastern in 1962"

Robert H. Probert
Secretary-Treasurer

SOUTHERN TIER

Christmas Party Enjoyed

The annual Christmas Party took the place of our regular monthly meeting on Dec. 14. A group of fifty members and their wives plus guests thoroughly enjoyed a semi-formal buffet dinner and dance held at the Aw-Wa-Ga Hotel, Owego, N. Y. A special treat in the form of entertainment was supplied by member **J. Bunsic** who showed colored moving pictures taken at the summer picnic. Our thanks to **Bruce Wells,** committee chairman, for the fine arrangements on the party.

W. Rossiter
Secretary

TWIN CITY

Wesley and Saubestre Speak at December Meeting

The Twin City Branch held its regular monthly business and technical meeting at Jax Cafe in Minneapolis, Minnesota, on Dec. 2. Forty-two per cent of the membership and eight guests were present.

Branch President **Warren Johnson** introduced National Third Vice President **W. Andrew Wesley** who spoke briefly to the members. The main theme of his address was the relationship between the Branches and the National Society.

Our technical speaker for the evening was **Dr. Edward Saubestre** of Sylvania Electric Products, Inc. He delivered an extremely interesting and informative lecture on "Plated Wiring". A short question and answer period followed.

WATERBURY

Christmas Party Takes Place of Regular Meeting

There was no meeting for December. A Christmas Party was held at D'Angelo's Restaurant Thursday, December 12. The party was very well attended and all enjoyed a good time. The Committee, consisting of **Lou Porretti,** chairman, and **Frank Schneiders** and **Michael Orient** did a very fine job.

The next meeting will be held at the Roger Smith Hotel, Jan. 9, 1958. **Isidore Cross,** our librarian, has chosen a panel for the program and it should be very interesting.

Nicholas Topazio
Publicity Director

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ELECTIONS

Boston: R. F. Gladu, J. W. Guinny, E. G. Judkins, R. H. Lawlor, R. D. L'Italien, L. A. Lucas, P. S. Morin, J. P. Raleigh, R. Scyzgial, J. P. Sydow
British Columbia: G. L. Young
Capitol District: W. J. Cox
Chicago: J. W. Carlson, W R. Crawford, P. T. Hall, A. Lenio, E. A. Siegfried, J. I. Wiarda
Cincinnati: F. J. Moser
Columbus: P. F. Martin, J. C. Weekley
Detroit: M. L. Baig, R. A. Brown, E. F. Chapman, R. C. Gustafson, P. Hornick Jr., P. Leenders, F. J. Lester, M. B. Martin, P. O. Sawyer, J. F. Sullivan Jr., L. G. Tomaszewski, T. W. Tomaszewski, S. L. Withrow, F. Zagari
Grand Rapids: E. F. Baroum, L. A. Bianchi, N. Bianchi, J. M. Bowker, C. Buckingham, G. L. Dutmers, A. J. Jackson, R. O. Knudson, D. Laird, W. M. McGee
Lancaster: C. H. Cline, L. Feese, J T Johnson, S. R. Kestor, M. R. Wilt, P. Zimmerman
Los Angeles: D. Davis, J. Ghio, P. O. Kerrigan, F. Kilmer, W. A. Moeur Jr., N. W. Nielson
Milwaukee: R. L. Brown, C. F. Colley, R. A. DesMarais, G. Ireland Jr., C. R. Jones, T. Kaltenbach
Newark: F. Dalton, H. Maroney, J. S. Palaszewski, C. Rust, C. A. Rutgers, S. F. Stross, A. Winter
New York: H. G. Abbey, L. H. Kraus
Philadelphia: C. S. Aloneftis, W. Beckhardt, R. E. Bono Jr., H. W. Gripton, R. Maturo, D. J. O'Sullivan
Pittsburgh: A. Sandler, R. L. Spielvogel
Saginaw Valley: H. E. Curtis, B. Gilchrist, L. Ireland, F. K. McCurdy, K. J. Plumb, L. M. Scudder
St. Joseph Valley: D. R. Culp, J. A. Croussore, R. E. Davis, R. E. Neff, R. Sprague Jr., F. L. Swoap
St. Louis: H. L. Cissell, J. G. Delovoski, W. Floyd, W. L. Leonard, E. Martin, I. Moore, F. W. Mosher, H. L. Nelson, G. Popo, H. K. Rice, J. D. Slater Jr., G. Steffen, R. VanMeter, F. W. Young
Southeastern: C. L. Eberlein, R. J. Greene
Sydney: W. M. Page, J. R. Stewart
Toronto: J. J. Masterson, E. S. Wilson

REINSTATEMENTS

Detroit: P. Hoeffel
Newark: K. Curry
Pittsburgh: J. P. Coros, M. Good
St. Joseph Valley: G. Stahl
St. Louis: A. Hunning, P. Sarakas

TRANSFERS

Columbus: W. Hespenheide to Philadelphia
Detroit: L. B. Belanger from Saginaw Valley, R. Dargis from Hartford, F. Maker from Indianapolis
Grand Rapids: R. W. Jewell from Detroit, E. F. Taylor to Hartford
Hartford: R. Dargis to Detroit
Indianapolis: J. A. Henricks to St. Joseph Valley, F. Maker to Detroit, C. E. Weekly to Los Angeles
Louisville: J. Muscarella Jr., from Newark
Newark: E. Collins from Waterbury, J. Muscarella Jr., to Louisville, R. Sonnenfeldt to Syracuse
Philadelphia: W. Hespenheide from Columbus, W. J. Miller Jr. to Blue Ridge, J. L. Stephens to Chicago
Saginaw Valley: L. B. Belanger to Detroit
St. Louis: R. Smith to Wichita
Waterbury: E. V. Collins to Newark
Member-At-Large: C. Hyde to Blue Ridge

RESIGNATIONS

Chicago: E. A. Anderson, I. Falko, E. Fell, A. Lazaro, M. Lillis
Louisville: J. Kehrer, I. L. Waterhous
New York: H. Berman
Sydney: S. S. Cook

SUSPENSIONS

Central Michigan: H. E. Kratzer, B. N. Sisco
Chicago: L. Bell, M. Brandt, J. Celmer, P. Cramer, C. Crowley, J. Daley, R. Dinsmore, H. G. Dobler, C. Dobson, W. L. Donovan, W. Finn, B. Fisher, V. Giammona, R. Hawthorne, F. M. Hubrick, M. Johnson, R. Johnson, J. C. Juneau, J. Kemp, R. Kidwell, M. Konchan, M. Kronenberg, J. Kronsbein, R. Landon, L. Larsen, R. V. Leonardson, C. C. LoDico, J. Maple, F Moyer, T. F. O'Brien, C. P. Olsen, P. Pelletier, S. Pieters, A. Piscator, C. W. Rink, L. T. Schubert, E. Stevens, P. Stevens, W. Traise, E. J. Tyrpak, M. Vatikum, S. Weincouff, H. Westergaard, M. Willigman, L. Wybel, R. Yackley, H. E. Younger
Grand Rapids: V. R. Bishop, T. Downey, J. A. VanderWerf
Louisville: W. F. Chapman
Newark: W. Nattrass, Z. Paracanay
New York: P. Parmenter
St. Joseph Valley: A. R. Mishler
Syracuse: J. Courtney, T. Duval, R. A. Gullotta, J. A. Howard, P. N. Jacques, J. Johnson, J. A McKeown, H. P. Munger, D. E. Percy

DEATHS

Grand Rapids: L. Grove
Pittsburgh: J. Weigand

CLASSIFIED ADVERTISEMENTS

Only "Help Wanted" and "Situations Wanted" will be accepted. Rates: $.20 per word, minimum $5.00. AES branch members and members-at-large only, in good standing, are entitled to a total of three *free* advertisements in any twelve month period as of first insertion. Last day for inserting advertisements is the 10th of month preceding date of publication. When answering advertisements please address as follows: Box number, PLATING, 445 Broad Street, Newark 2, N. J.

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FUTURE MEETINGS

AES

February 14-15—**Southeastern Branch,** 3rd Annual Technical Session, Dinkler-Plaza Hotel, Atlanta, Ga.

February 15—**Cleveland Branch,** Annual Educational Session and Dinner Dance, Hotel Carter, Cleveland, Ohio.

February 15—**Grand Rapids Branch,** Annual Banquet, Pantlind Hotel, Grand Rapids, Mich.

February 26—**Editorial Board Meeting,** Sheraton-Gibson Hotel, Cincinnati, Ohio.

March 1—**Dayton Branch,** Annual Educational Session and Dinner Dance, Hotel Biltmore, Dayton, Ohio.

March 12—**Research Committee Meeting,** Palmer House, Chicago, Ill.

March 15—**Rockford Branch,** Annual Educational Session and Banquet, Faust Hotel, Rockford, Ill.

March 21-22—**Executive Board Meeting,** AES Headquarters, Newark, N. J.

April 12—**Baltimore-Washington Branch,** Annual Banquet, Presentation of the Pot, Park Plaza Hotel, Baltimore, Md.

April 12—**19th Annual New England Regional Meeting,** Hotel Statler, Hartford, Conn.

April 19—**4th Empire State Regional Meeting,** Seneca Hotel, Rochester, N. Y.

May 3—**Boston Branch**—Annual Educational Session and Banquet, Hotel Statler, Boston, Mass.

May 19-22—**45th AES Annual Convention,** Sheraton-Gibson Hotel, Cincinnati, Ohio.

November 1—**Philadelphia Branch,** Annual Educational Session and Banquet, Hotel Sheraton, Philadelphia, Pa.

June 14-18, 1959—**Golden Jubilee Convention and International Exposition, AES,** Detroit, Mich.

July 10-14, 1960—**47th AES Annual Convention,** Hotel Statler, Los Angeles, Calif.

INTERSOCIETY

February 10-14—**American Society for Testing Materials,** Committee Week, Statler Hotel, St. Louis, Mo.

March 17-21—**National Association of Corrosion Engineers. 14th Annual Conference,** Civic Auditorium, San Francisco, Calif.

April 27-May 1—**The Electrochemical Society, Spring Meeting,** Statler Hotel, New York, N. Y.

May 5-7—**13th Purdue Industrial Waste Conference,** Purdue Memorial Union Building, Purdue University, Lafayette, Ind.

June 9-12—**National Materials Handling Exposition,** and American Society of Mechanical Engineers National Conference on Materials Handling, Public Auditorium, Cleveland, Ohio.

June 22-27—**American Society for Testing Materials,** Annual Meeting and Exhibit, Hotel Statler, Boston, Mass.

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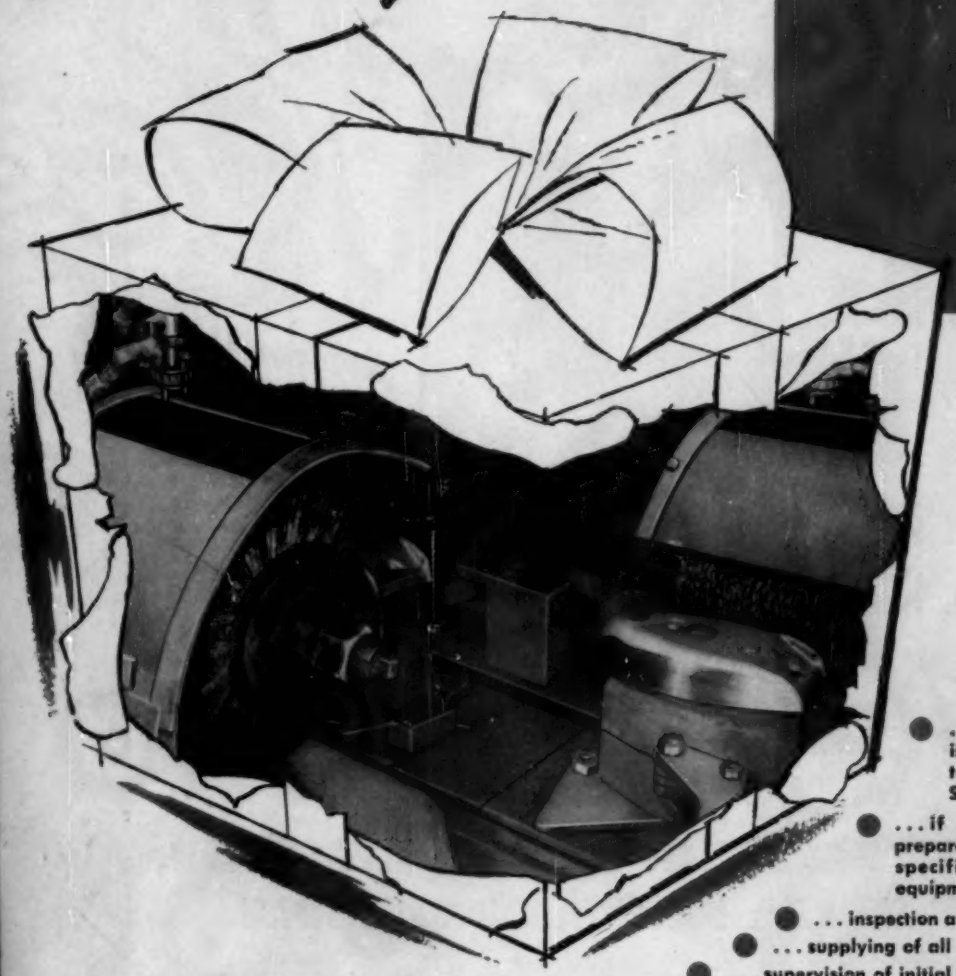

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THE LEA MANUFACTURING CO.
16 CHERRY AVE., WATERBURY 20, CONN.

Lea-Middgen, Inc., 14066 Stansbury Ave., Detroit 27, Mich.
Lea Mfg. Company of Canada, Ltd., 1236 Birchmount Road Scarborough, Ontario, Canada
Lea Mfg. Company of England, Ltd., Buxton, England
Lea-Rand, Inc., Main Office and Laboratory: 139-30 109th Ave., Jamaica 35, N. Y.
Manufacturing Plant: 237 East Aurora St., Waterbury 20, Conn.

INDICATE A-269.